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ABSTRACT

Career orientation in the science curriculum introduces students to science-related careers and opportunities and enables them to prepare an educational program if they choose a science career. The curriculum guide is designed to aid junior high school science teachers in relating the seventh and eighth grade science curriculum to careers in scientific fields. Learning activities are grouped into units examining: purposes and practices; measurement and matter; conservation--ecology; living things (subtopics: humans, animals and plants, adaptation--animals, microscope use and care, healthful living, and first aid); energy; work; heat; sound; light and seeing; electricity and its uses; water; air and weather; earth and the heavens; and plans, rockets, and space travel. Each unit includes an introduction, a list of suggested activities, worksheets, and selected references, audiovisual aids, and published sources. The appendix contains sections dealing with: (1) community resources in the science area (organizations, resource persons, committees, clubs, and references), (2) suggested procedures for field trips, and (3) a tabulated chart listing science-related careers arranged according to: level; service; business, clerical, and sales; science and technology; outdoor; general culture; and arts and entertainment. (JB)

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Career Orientation
Grade 7 and 8
A unified approach

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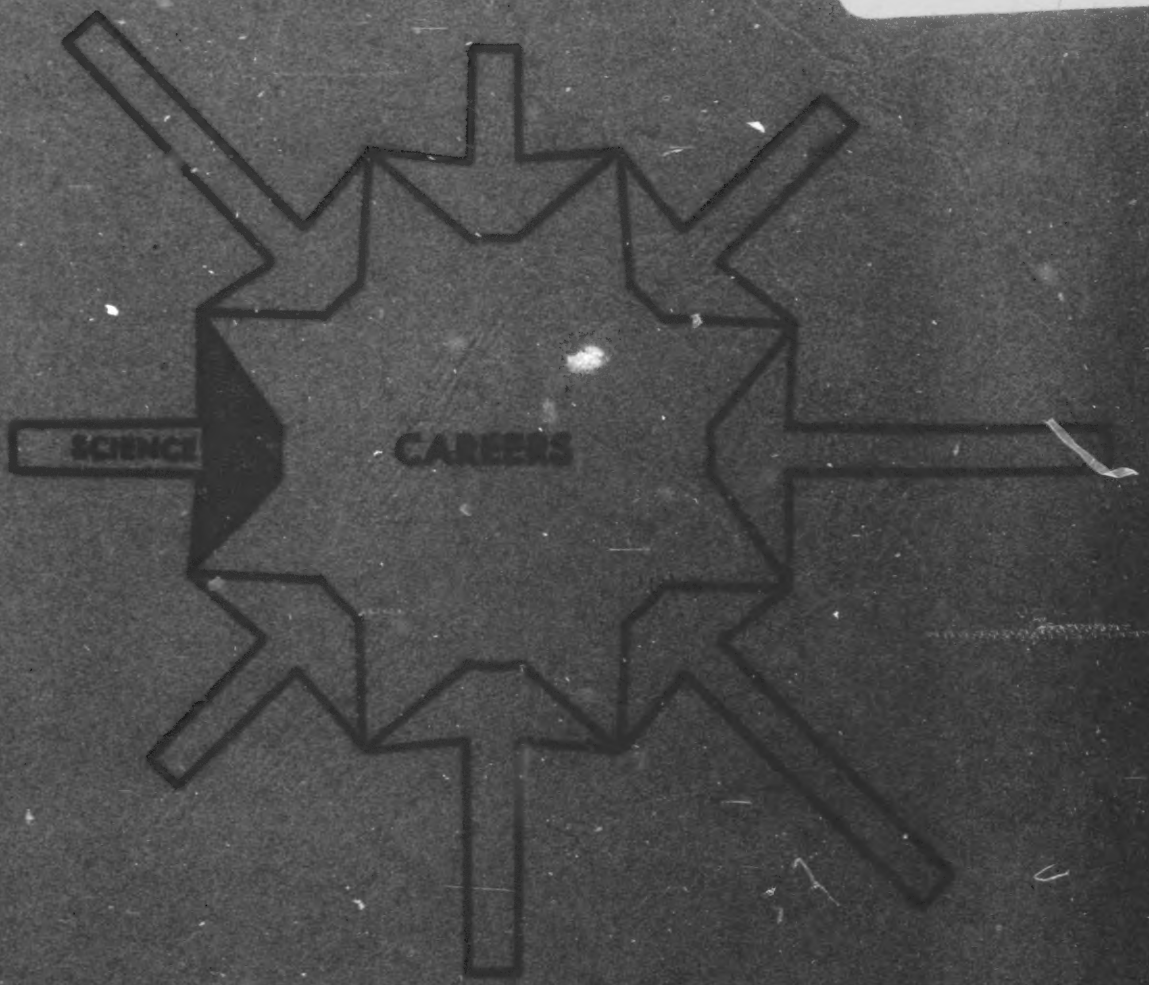

REVISED EDITION

ACTIVITY MANUAL

Cincinnati Public Schools

CAREER ORIENTATION

Science

Science offers pupils many career opportunities and the science teacher is in an excellent position to relate subject matter to science-related careers. Career discussion helps stimulate pupil thinking and is an essential, integral part of science courses of study. The science teacher has many opportunities, not necessarily present in other areas, for creating and sustaining interest: the natural desire of young people to investigate, experiment and question, the lure of science equipment such as microscopes and telephones, the interest in taking things apart, the science club and others.

The extent of science background and training needed for various careers varies widely from required secondary school courses through the specialized high school courses such as biology, chemistry and physics, technical school programs, two year colleges, universities and university graduate programs. Specific on-the-job training is involved in most vocations and the duration may be brief or extend over a number of years.

This bulletin is designed to aid science teachers relate the science curriculum to the careers in scientific fields. Additional career information is available from references cited in this bulletin, vocational books and pamphlets available from counselors, school and public libraries, and by direct contact with persons in local business and industry.

The science activity manual was developed during the summer of 1969, revised in 1970 and again in 1971 as a result of trial experiences. Kenneth E. Vordenberg, Administrative Supervisor of Secondary Science,

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CAREER ORIENTATION

Science

Seven and Eight

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UNIT I

PURPOSES AND PRACTICES

This unit should be used as an introductory unit to the study of science. Its importance lies mainly in establishing in the pupil basic attitudes and patterns of thinking. Teaching the pupil to think and reason in a logical manner and to arrive at accurate conclusions based on the known facts is a basic goal. Regardless of the occupation followed, attitudes are as important to success as anything else.

ACTIVITIES

No. of Activity

1 Definition Science

Guide pupil discussion toward the following definition of science: "The organized knowledge gathered by man in his search for truth."

Point out in this definition that any organized knowledge, whether in history, English, chemistry, physics, or whatever, is a science. Stress the importance of all subjects. How can anything be learned without language? How can anything be measured without mathematics? How have events in history affected developments in science, such as, the science of aviation? How have scientific and technical developments affected history?

2 Reasons for Studying Science

Have the pupils give reasons for studying science. List these reasons on the board. The following should be included in such a list:

a. To overcome fear and superstititon.

Discuss reasons why the ancient Greeks and Romans had so many gods and goddesses.

b. To make life more meaningful and interesting.

c. To enable an individual to think more effectively.

Discuss the fact that our brains form our thoughts out of what we know (Knowledge). Thus, the more we know the more and deeper thoughts we are able to have.

d. To aid everyday safety and health.

e. To prepare for vocations and avocations.

3 Vocations--various levels

Define "vocation" and have the pupil list various vocations. Put the list on the board. Make sure this list includes the work of professions, trades, technicians, skilled and non-skilled laborers.

4 Avocations

Define "avocation" and have pupils list as many as possible. Put this list on the board. Point out how a vocation for one person may be an avocation for another.

5 Scientific Method

Discuss the "Scientific Method", listing on the board the six steps involved. Worksheet 5a

6 Using Scientific Method

Pick some problem of which the pupils are aware but are not likely to know the answer. Such a problem might be "Why does

WORKSHEET 5a

PURPOSES AND PRACTICES

NAME _____

DATE _____

Can you use the scientific method for solving your problems?

1. In what ways do you learn to do things you have not done before _____

_____

2. What is a problem? _____

_____

3. What is meant by solving a problem? _____

_____

4. In what three ways may problems be solved? _____

_____

5. Observe some objects in your classroom. What do you observe? List as many things as possible.

_____

Objects Observed	Size or Shape	Color	Surface	Odor

WORKSHEET 6a

PURPOSES AND PRACTICES

NAME _____

DATE _____

Step II - Observation

1. What is meant by observation?

2. What five senses are used in observation? (a) _____ (b) _____

   (c) _____ (d) _____ (e) _____

3. Which sense or senses are used to get information in each of the following events?

   (a) Sour food _____

   (b) Running water _____

   (c) A cold classroom _____

   (d) A smooth object _____

   (e) A pencil dropped on floor _____

   (f) Gas leaking into the classroom _____

NAME _____

DATE _____

4. List five careers that depend upon observation in their occupation.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

5. What are three characteristics in each of the following dogs that make it possible for you to decide which dog is which?

   a. Bulldog (1) _____

   (2) _____

   (3) _____

   b. Collie (1) _____

   (2) _____

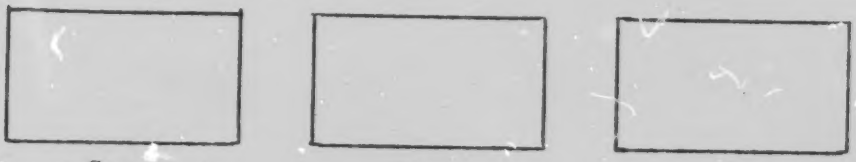
   (3) _____

   c. Great Dane (1) _____

   (2) _____

   (3) _____

6. a. In the following spaces provided, place a drawing of the general shape and characteristics of:



Cow Frog Snake

   b. What do you consider to be the most important characteristic of each animal that makes it different from the other animal?

   Cow _____

   Frog _____

   Snake _____

the shortening spatter when potatoes are sliced into it"? Solve this problem using the "Scientific Method". Point out that a statement of a problem such as the statement above is not detailed enough to prevent misinterpretation. A scientisit must be more accurate and detailed. Worksheet 6a.

7 Illusions

Show the pupils a dozen or more illusions, pointing out how our senses can be fooled (a moving picture and a T.V. set are practical applications of this) and that this is the reason a scientist must make so many different kinds of observations before he can be fairly sure that his observation is correct.

8 Perseverence--A Trait of Scientists

Have pupils report on the work of Thomas A. Edison, Dr. Salk and others to show how they persevered. A scientist must not give up when failure hits. He must keep trying.

9 Contributions of Prominent Biologists

Have pupils report the work of the following scientist. They may act out certain parts of their reports and have other members in the class guess the biologist.

Some examples:

A. Bessey, Charles Edwin (1845-1915)

Ans. _____ Systematisv and teacher of botany

B. Comstock, John Henry _____ (1849-1931)

Ans. _____ First professor of entomology in American University

C. Fleming, Dr. Alexander _____ (1881-)

Ans. _____ Discovered penicillin in molds

D. Galton, Sir Francis _____ (1822-1911)

Ans. _____ Established the Science of Eugenics

E. Goldberger, Joseph (1874-1929)

Ans. _____ Discovered the cause, cure, and prevention of pellagra

R. Lister, Sir Joseph (1827-1912)

Ans. _____ Introduced the use of antiseptic surgery.

10 Showing the derivation of words

This activity may motivate a study of science words and concepts from the previous activity. For example: John Henry Comstock was an entomologist. The teacher may show that most words ending in ology involve the study of something and ologist refers to a person who specializes in that particular field.

Selected References

Books from public and school libraries:

Beveridge, W. Art of Scientific Investigation. W. W. Norton & Co., Inc.

Fortune Magazine. Mighty Force of Research. McGraw-Hill

Freedman, Paul. Principles of Scientific Research. Public Affairs Press

Furnes, C. Research in Industry. Van Nostrand Co.

Hertz, D. Theory and Practice of Industrial Research. McGraw-Hill

Hillway, Tyrus. Introduction to Research. Houghton-Mifflin Co.

Pollack, P. Careers and Opportunities in Science. Dutton & Co.

Stevens, W. Famous Men of Science. Dodd, Mead and Co.

Whitney, F. Elements of Research. Prentice-Hall

Of particular importance for this unit and any of the following, are the vocational and work unit files at the Cincinnati Public libraries.

Suggested Films

227	Careers in Engineering
1743	Science and Superstition
1947	Using the Scientific Method
2096	Our World of Science
2212	The Metric System
2338	Visual Perception
2428	How a Scientist Works
2663	American Road

Filmstrips

6858	Why Study Physics
7079	Geophysical Year

Sources of free and inexpensive materials

1. Science and Your Career, U. S. Department of Labor, U. S. Government Printing Office, Washington, D. C. 20210
2. Ohio State Department of Education, Division of Vocational Education, State Office Building, Columbus, Ohio 43215
3. Public Relations Staff, General Motors, Detroit 2, Michigan
4. National Science Teachers Association, 1201 16th Street, N.W., Washington, D. C. 20036
5. Battelle Memorial Institute, Columbus, Ohio
6. American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, DC 20205

A complete listing of organizations representing their specific occupation can be found in:

Encyclopedia of Associations,
National Associations of the U. S.
Gale Research Company
Detroit, Michigan

UNIT II

MEASUREMENT--MATTER

ACTIVITIES

No. of Activity

1 Forms of Matter

Show that solids, liquids, and gases are forms of matter because they occupy space and have mass. A book and a uniform block of wood are solids that can be measured and weighed easily. Pouring water into a glass jar will show that a liquid occupies space, and weighing the jar before and after pouring will show the liquid has mass. Point out the many careers that use precise measurements in the work. Worksheet 1a

2 States of Matter

Refer to activity No. 1 above to show that a solid has a definite size and shape, and that a liquid has a definite size but not a definite shape. Pump air into a deflated bicycle tire to show that a gas does not have a definite size or shape but spreads out until it has the same size and shape of its container. Place some ice cubes in a pyrex container and allow them to melt. Then heat the water until it boils. Point out the changes in state that have taken place. Have the pupils make a list of familiar changes in state that take place around them. Let the children discuss the various careers that use this knowledge, such as the chemist, pharmacists, physicists, etc.

3 Properties of Matter

Have the children bring in a variety of materials from home, and ask them to describe some of their physical properties. Such properties could easily include size, shape, color, texture, hardness, density, odor, taste, and solubility in water. Have pupils list the careers that use this knowledge about the properties of matter. For example, a child brought in a nail - the persons using this knowledge could be a chemist, physicist, metallurgist, etc.

4 Molecular Motion

Place a spoon in a cup of hot water. Point out that the part of the spoon above the water becomes hot because of molecular motion. The heat of the water makes the molecules in that part of the spoon below the water move faster and so the spoon becomes hot. These faster moving molecules strike nearby molecules in that part of the spoon above the water, making them move faster, too. Soon this faster molecular motion is transmitted throughout that part of the spoon above the water, and that part becomes hot.

5 Elements and Symbols

Have the pupils make an alphabetical list of all well-known elements and their symbols. Such information can be found in a chemistry textbook or an encyclopedia. Note how the symbols in most cases provide a clue to the name of the element. Where the symbol does not correspond with the name of the element, have the pupils find out from the encyclopedia the element's name in another language from which the symbol was derived.

WORKSHEET 1a

MEASUREMENT-MATTER

NAME _____

DATE _____

1. List two ways in which matter is different from energy

   1. _____

   2. _____

2. In the list of words below, place an M by those items which are matter and E by those which are energy:

a. Water _____	d. Thunder _____	g. Hydrogen _____
b. Steam _____	e. Nail _____	h. Smoke _____
c. Light _____	f. Book _____	i. Electricity _____

3. Is water matter? _____ Why?

4. List three special characteristics you would use to identify water

   1. _____

   2. _____

   3. _____

WORKSHEET 5a

MEASUREMENT-MATTER

NAME _____

DATE _____

Name of Elements	Symbol	Atomic No.	Atomic Weight	Physical Properties	Chemical Properties	Discoverer	Uses
Carbon							
Calcium							
Chlorine							
Copper							
Helium							
Hydrogen							
Iron							

This activity could relate to many careers such as the chemist, physicist, etc. Worksheet 5a

6 Elements

Make a collection of easily available elements such as iron, copper, silver, gold, aluminum, magnesium, tin, zinc, carbon, and sulfur. (The evaporation of tincture of iodine will also provide the element iodine.) Point out that all the atoms of a given element are the same, but the atoms of different elements differ from each other.

Divide the elements into two groups: Metals and non-metals.

Make a list of all properties that metals have in common.

List some of the ways that metals differ from each other.

Compare the differences between metals and non-metals.

Provide for use and repetition of new words and symbols.

Have pupils list careers that use each of the materials in the two groups. Also, let one group list the various products made from the metals.

7 Some substances are more soluble in water than others

Add equal amounts of water of the same temperature to each of three test tubes. Add a level teaspoon of sugar to the first test tube, a level teaspoon of sodium bicarbonate to the second test tube, and a level teaspoon of salt to the third test tube. After placing your thumb over the mouth of the test tube, shake each test tube vigorously ten times, and then place the test tubes upright and allow any undissolved material to settle. Note the degree of solubility of the three different materials.

8 Tour - Waterworks

Take the pupils on a tour to Cincinnati Waterworks. Point out the various careers found within the plant.

9 Soil and Water

Invite someone from Hamilton County Soil and Water Conservation District to speak to the class.

10 Physical and Chemical Changes

Have the pupils cut up a piece of paper or wood into small pieces, and then burn it. Note that cutting the paper or wood is a physical change, but burning the material is a chemical change. Compare the basic differences between physical and chemical changes.

11 Cohesion and Adhesion

Place a drop of water on a mirror or piece of glass. Observe that the drop of water remains intact because of the cohesive forces between the water molecules, whereas the water adheres to the glass because of adhesion.

Selected References

Parker, Bertha M. Gravity, New York, Harper. 1967, 36 pp.

Watson, Jane Warner, and Bertha M. Parker. The Everyday Atom, New York, Harper, 1969, 36 pp.

Careers Kit, Largo, Florida

Science Kit

Health Kit

Suggested Films

1909	Explaining Matter
239	Technicians in Our Changing World
1260	The Welding Operator
2080	A Visit to the Waterworks
1641	Water Cycle

Filmstrips

7635	Preparing for the World of Work
6858	Why Study Physics
6860	Structure of Matter

UNIT III

CONSERVATION--ECOLOGY

The basic reasons and needs for the study of conservation are found in the crisis of survival. The main problems of conservation in the modern world are resulting from the pollution of the environment. This pollution has become so critical that some scientists are saying that if the problems resulting from it are not solved in this decade (the 1970's) we will have reached the point of no return and all higher forms of life on earth will be lost. In fact, some scientists are afraid that this point of no return has already been reached. Therefore, a study of conservation at this time is very crucial, and the science-social significance of it for the individual, the community, the nation and the entire world is almost incomprehensible.

To guide pupils' thinking about the importance of conservation and perhaps directing them into careers which will lead them to help solve its problems, the following group of activities may be useful.

ACTIVITIES

No. of Activity

1 List forms of the destruction of our environment

(All activities following this will be based upon this list.)

Possible list

a. Removal of forests and ground cover by fire, cultivation, bulldozing, mining, logging, etc.

b. Covering water absorbing acres with concrete and asphalt

c. Pesticides and fertilizers

d. Industrial pollution

e. Community pollution other than industrial

f. Burning of hydrocarbon fuels - automobiles, etc.

g. Non-degradable wastes including metallic and plastic

h. Radioactive wastes

i. Noise pollution

j. Thermal pollution

k. Erosion

l. Wasting of mineral and fossil resources

m. Wasting of water

n. Water pollution

o. Air pollution

p. Interaction between air, water and soil pollution

q. Saturation of living space - population explosion

r. Destruction of natural beauty

2 List (and where possible, demonstrate) the harmful effects of each of the above. Also, give possible solutions.

3 Possible experimental type activities to be done with 1 and 2.

a. Removal of forests and ground-cover

1) Use two stream tables, one with bare soil, the other with a ground cover such as grass. Elevate one end of each table slightly (both tables the same). Sprinkle water from a sprinkling can on each set-up (using the same amount of water on each) and observe the effect of ground-cover or a lack of it on erosion.

2) With the same set-up as above but with both tables flat, note effect of drops of water hitting covered and uncovered soil.

3) Set up a microcosm with animals but no plants. Observe effect of decreasing oxygen supply on animals.

b. Covering acres with concrete and asphalt.

1) Use two stream tables with soil in one-half the length of each. In one of the tables, place a strip of plastic, one-fourth of the width of the table, the full length of the soil. Tilt both tables slightly (both the same) with the soil-less end down. Sprinkle the same amount of water on the same part of the soil in each table. Note the rate of runoff into the lower end of both tables.

c. Pesticides and fertilizers

1) Prepare a large aquarium with one-half as a terrarium and the other half as a "pond" containing small fish (guppies preferred). (Separate the two sections with a loose laid rock wall). Put excess of commercial fertilizer on terrarium half. Keep water level in pond constant by sprinkling terrarium half. Observe cumulative effects of fertilizers on fish.

As a control, run another set-up the same but without the fertilizer.

2) Set up an aquarium with small goldfish or guppies. Spray all food given to fish with a commercial pesticide. As a control, run another set-up without spraying the food. Observe the effects of the pesticide on the fish.

d. Industrial and Community Pollution
and e.

1) Collect samples of fall-out on fall-out plates from various sections of city, suburbs, parks, etc. With a microscope count the fall-out particles per square centimeter. All samples must be collected with the same length of exposure and preferably at same time of day for comparison. Samples should also be collected in the same area at different times of the day for comparison.

2) An air sampling filter, such as is used by the "City Air Pollution Control", can be used instead of the fall-out plates in the above experiment to sample pollution in given volumes of air.

3) Obtain or make pamphlets to distribute in neighborhood telling how they can help to stop industrial and community pollution.

f. Burning of Hydrocarbon fuels

1) Burn fuel oil in an <u>open</u> metal container. (<u>Make sure opening of container is as large as the surface of the oil to prevent an explosion</u>.) Observe odors as evidence of invisible pollution.

Observe smoke and collect carbon by holding a beaker above the flame as evidence of visible pollution.

2) Obtain or make pamphlets to distribute to neighborhood explaining how motorists can help reduce hydrocarbon pollution by such things as regular motor tuneups, limiting idling, timing of engines, etc.

g. Non-degradable wastes including metallic and plastic.

1) Agitate water with detergent in it to produce suds. Observe how long it takes the suds to break down. Then regularly agitate the water until agitating it no longer produces suds. Note how many months this takes if it ever reaches this point. This should be done with both non-degradable and degradable detergent.

2) Put a piece of tin can in a glass container of water. Keep metal covered with water and note how many weeks it takes to change completely to rust.

3) Put a piece of plastic container into various acids, bases, etc. and observe their indestructibility.

h. Radioactive wastes

1) Make a list of radioactive materials with their half lives. (This makes a good library project for some pupils.) Discuss what "half life" means

and its importance in the disposing of such materials. Also discuss leakage of radioactive materials from nuclear reactors.

i. Noise pollution

1) Have class solve problems under different noise levels from complete quiet to very loud "rock and roll" music. Record problems worked correctly and the time required to work them under each situation.

2) List noise sources (and if possible the decibels of each) found in the school and neighborhood. If decibels are obtainable compare with maximum safe level - 120 db.

3) Obtain noise levels in various occupations and compare with the maximum safe level - 120 db.

j. Thermal pollution

1) List and discuss both natural and man-made sources of thermal pollution.

2) Set up an aquarium of inexpensive tropical fish. Raise the temperature at least 10° above the optimum for the fish (75°F.) and observe the effects of this over a period of several days. Run the same set-up at optimum temperature as a control.

3) Run the same set-up as in 2), but lower the temperature at least 10° below the optimum temperature.

k. Erosion

1) Measure the width and depth of a small rill. After a heavy rain measure the width and depth of the rill at the same place and determine roughly the amount of material eroded from that rill alone during that one rain.

2) Obtain samples of water from a stream during normal and flood flow. Alow the samples to sit thirty-four hours without being disturbed and determine the percentage of sediment in the water at the two times.

3) Refer to experiments in a and b.

l. and m. Wasting of mineral, fossil and water resources. Calculate the materials lost and money wasted in the following situations:

1) Leaving a car engine idle for one hour.

2) Allowing a light bulb to burn for eight hours for no good reason.

3) Allowing gas to be used for decorative purposes such as at the Forum Apartments on Dixmyth Avenue.

4) Adjust a faucet to a slow drip. Catch the water in a measured container for twenty-four hours. Determine the amount of water that would be wasted in one day, in one week, and in one year. Determine the amount of water wasted in one year if every home and public building in Cincinnati had one leaking faucet.

n. Water pollution

1) Obtain samples of water from various polluted streams. Attempt to have small fish live in these samples. As a control, keep the same kind of fish in clean, fresh water.

2) Observe samples of contaminated and fresh, clean, uncontaminated water under a microscope. Draw pictures of observations.

3) Refer to experiments in 3 - c., g., and j.

o. Air pollution

1) Make a cloud chamber in a large flask or jug as follows: Put one inch of water in the container. Stopper the container with a two-hole stopper containing short glass L tubes. Place a short hose (6 inches) on the outer end of each tube. Put a clamp on each hose. With both clamps open and sucking on one of the hoses, draw smoke from a burning match into the container through the other hose and tube. Close the clamp on far hose and force air into the container. Release the pressure suddenly and a cloud will appear. Increase pressure in the container again and the cloud will disappear. Try the same thing but without the smoke. No cloud will appear. This shows the effects of solid pollutants in the production of clouds, fog and smog.

2) Refer to 3 - d and e, 1) and 2) for other experiments.

p. Interaction between air, water and soil pollution

1) Set up a balanced microcosm and compare with results of unbalanced situation in 3 - c., n., and g.

2) As a class project, have pupils write letters on environmental pollution control to be sent to important public officials.

q. Saturation of living space - population explosion

1) Overpopulate an aquarium or microcosm. Observe the results after several weeks and compare them with a balanced set-up used as a control.

4 Suggested Field Trips

		Best suited for the following activities from Section 1
A.	Millcreek Sewage Disposal Plant	e, g, m, n
B.	Neighborhood industries	d, f, g, h, i, j, l, m, n, o
C.	Polluted areas of the Ohio and Little Miami Rivers	a, d, e, g, k, n
D.	Cincinnati Water Works	d, e, g, k, m, n
E.	Hunting reserves	a, b, r
F.	Cincinnati Nature Center	a, k, r
G.	Fairview Park (to observe air pollution)	d, f, k, o, r
H.	County Parks	k, r
I.	Fish hatcheries (State preferred)	n, p, q
J.	Local streams	a, b, d, e, g, k, m, r
K.	Local incinerator, city dump and auto graveyard	a, b, c, f, g, j, o, p, t

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13. The Next Ninety Years. Proceedings of a Conference sponsored by the Office for Industrial Associates at the California Institute of Technology. March 7-8, 1967. California Institute of Technology, Pasadena.

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18. Rudd, Robert L. 1966. Pesticides and the Living Landscape. University of Wisconsin Press, Madison, Milwaukee, London.

19. Thompson, Warren S., and David T. Lewis. 1965. Population Problems. 5th Edition. McGraw-Hill Book Company, Inc., New York.

Suggested Films

181	The River Valley
214	The Survivors
272	The Temperate Deciduous Forest
360	Beargrass Creek
362	The Succession from Sand Dunes to Forests
371	Population Ecology
496	Conserving Our Water Resources Today
561	The Enduring Wilderness
625	Man Uses and Changes the Land
667	Making the Desert Green
702	Our Endangered Wildlife
703	Tomorrow's World: Feeding the Billions
715	Problems of Conservation--Air
718	The Everglades: Conserving a Balanced Community
1474	Conservation Road: Story of Our Natural Resources
2318	Balance in Nature

Filmstrips

6660	Fire Safety
6720	Forests of the United States
6518	Tree Surgery
6578	Tree Planting
7152	Conservation Concepts

7197 What is Conservation

7275 The Grasslands: The Story of a Major Community

7276 The Swamp: Some Relationships between Organisms

7280 The Forest: A Stable Community

7314 Living Things Need Each Other

7360 Insects: Man's Greatest Rival

7367 Conserving Our Water

7368 Lets Keep It "America The Beautiful"

7676 Air-Sea Interaction

Slides

5286 Lumbering

Sources of free and inexpensive materials for conservation:

1. American Forest Products Industries, Inc., 1816 North St., N.W., Washington, D. C.
2. Conservation Education Association, Eastern Montana College of Education, Billings, Montana
3. Conservation Foundation, 30 E. 40th St., New York, N.Y.
4. Elementary Teachers Guide to Free Curriculum Materials, 14th Ed., Educators Progress Service, Randolph, Wis., Annual, 1957.
5. National Audubon Society, 1130 Fifth Ave., New York, N.Y. 10028
6. National Recreation Association, 8 W. 8th St., New York, N.Y. 10011
7. National Wildlife Federation, 232 Carroll St., N.W., Washington, D.C. 20012
8. Indiana Petroleum Council, 509 Circle Tower Building, Indianapolis, Ind. 46204
9. Peabody College for Teachers, Free and Inexpensive Learning Materials, George Peabody College for Teachers, Nashville, Tenn., Annual, 1956.
10. Resources for the Future, Inc., 1145 Nineteenth St., N.W., Washington, D.C.
11. Sport Fishing Institute, Bond Building, Washington, D. C. 20005

12. Wildlife Management Institute, Wire Building, Washington, D.C. 20005

13. Handbook for Teaching Conservation and Resource-Use, National Association of Biology Teachers, Richard L. Weaver, Project Leader, P.O. Box 2073, Ann Arbor, Mich., 1955.

14. Air Pollution Control League, 2400 Reading Rd., Cincinnati, Ohio 45202.

15. State of Ohio Safety and Hygiene Division, 1717 Section Road, Cincinnati, Ohio

16. U.S. Public Health Office, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

17. U.S. Environmental Science Services Administration, U. S. Post Office and Court House, Cincinnati, Ohio

18. U. S. Environmental Control Administration, 5555 Ridge Ave., Cincinnati, Ohio

19. National Air Pollution Control Administration, 1055 Laidlaw Ave., Cincinnati, Ohio

20. Federal Water Pollution Control Administration, 4676 Columbia Parkway, Cincinnati, Ohio

Careers Related to Conservation--Ecology

Climatologist: compiles, makes statistical analyses of and interprets data on temperature, sunlight, rainfall, humidity and wind for a particular area over a long period of time for use in weather forecasting, aviation, agriculture, commerce, and public health.

Ecologist: compiles, makes statistical analyses of, and interprets data collected about the interaction of animals with their environments. He then offers technical assistance to any interested individuals or groups.

Game Warden: enforces federal, state and local wildlife statutes. His work includes field observation and patrol, conducting census of wildlife populations, and reducing damage to agricultural crops by protected species of wildlife.

Agronomist: discovers and develops strains of wild and cultivated plants which may prove to be of economic value.

Refuge manager: develops an environment which is most favorable to the growth and expansion of wildlife.

Fish hatchery manager: supervises the operation of fish breeding centers. Supplies streams and lakes with food and game fish.

Fish and Game Warden: studies the life history, habits, and economic aspects of fish and game to provide technical assistance to any interested individuals or groups. (See also Game Warden).

Wildlife biologist: concerned with the distribution, abundance, habits, life histories and economic values of birds, mammals and other wildlife.

Animal control biologist: concerned with reducing damage from predatory animals or injurious rodents.

Naturalist: studies wildlife natural to their area, preserves scientific specimens, collects records, plans museum exhibits and conducts study tours.

Park Ranger: protects and manages both animals and park visitors as well as presenting a clearer picture of the natural inhabitants of the area.

Oceanographer: attempts to obtain information about the ocean through extensive tests, observational programs, and detailed surveys and experiments.

Timberland manager: Plans and supervises logging for timber or pulp. He supplies the mill or plant with a continuous supply of wood.

Firefighter: trained for fighting small fires. Work water pump which is carried on the back to suppress the fire.

Fire Lookout: trained to spot and report fires in large (usually western) forests. Sometimes may be called upon to fight small fires.

Paleontologist: identifies, classifies and determines the significance of fossils found with the sediments.

Scout Leader: responsible for leading young people to an understanding of the outdoors.

Camp councilor: guides and directs young people in their understanding of the outdoors.

Summer jobs in the National Parks: a spectrum of jobs are available in the National Parks: everything from selling in the Park store to being a guide.

Tree surgeon: responsible for treating any abnormal tree condition.

Sanitation engineer: studies waste problems and designs methods of waste disposal.

Construction engineer: operates or is responsible for the operation of various types of power driven machines such as bulldozers, shovels, cranes, tractors and pile drivers.

Dentrologist: responsible for the identify of different types of woods for marketing.

Meteorologist: definition found in unit on air and weather.

Smoke Jumpers: they learn to land in tree tops and to control the chute over canyons and mountains where the up-and-down drafts are sometimes violent. They must know how to fight the fire and then find their way to a road or trail or to a place where a helicopter can pick them up. They learn how to read terrain, map and compass.

Personal qualifications include good general physical condition, initiative, resourcefulness, strong sense of responsibility, an honest and fair attitude, interest in the outdoors and conviction of the importance of resource management.

Employment opportunities may be through the American Forestry Association, American Institute of Park Execution, American Paper and Pulp Association and Association of State Foresters.

Detailed information may be secured from Western Forestry and Conservation, 712 U. S. National Bank Building, Portland, Oregon 97204; Society of American Foresters, Mills Building, Pennsylvania Avenue and 17th Street, Washington, D. C. 20006; Forest Products Research Society, P.O. Box 2010, University Station, Madison, Wisconsin.

Wood Architects--Timberland Manager: plans and supervises logging for timber or pulp (that is, soft wood that can be reduced to pulp to make paper of various kinds). He must supply the mill or plant with a continuous supply of wood.

Employment opportunities may be through the American Forest Association, American Institute of Park Execution, American Pulp and Paper Association and Association of State Foresters. Detailed information may be secured from Western Forestry and Conservation Association, 712 U. S. National Bank Building, Portland, Oregon 97204; Society of American Foresters, Mills Building, Pennsylvania Avenue and 17th Street, Washington, D. C. 20006.

Some summer work for high school graduates is available through the United States Forest Service. Applicants must be 18 years old, physically fit and willing to do hard physical work. Most of the jobs are in national forests in Montana, Idaho, California, Washington, Oregon and Colorado.

Technicians: may be timber cruisers (the men who mark the trees to be cut) or scalers who scale the board feet in each log. They may be researchers making studies on soil and growth, forest engineers, wood chemists or draftsmen. They may work in saw mills or paper plants.

Personal qualifications include good general physical condition, initiative, resourcefulness, strong sense of responsibility, an honest and fair attitude, interest in the outdoors and a conviction of the importance of resource management.

Employment opportunities may be through the Association of State Foresters, c/o Main Forest Services, Augusta, Maine; Association of Consulting Forest, 1740 K Street, N.W. Washington, D. C. 20006; American Forest Products Industries, 1816 N. Street, N.W., Washington, D. C. 20006.

Detailed information may be secured from the National Arborists Association, P.O. Box 426, Wooster, Ohio and Ranger Schools such as State Forest Ranger School of the School of Forestry, University of Florida, Lake City, Florida.

Fire Suppression Aids: these men are trained specifically in fighting small fires. They are the commandos who may go in by themselves or in small groups to (1) dig firebreaks (that is, to clear a belt several feet wide of vegetation so fire can't spread), (2) set back fires if necessary, (3) work pumps carried on their back and (4) hold the spread of fire even if they cannot put it out.

Personal qualifications include good general physical condition, initiative, resourcefulness, strong sense of responsibility, an honest and fair attitude, interest in the outdoors and a conviction of the importance of resource management. One must be able to stand loneliness, know how to cook their own food, have good eyesight and know how to fight small fires.

Sources of further information are National Arborists Association, P.O. Box 426, Wooster, Ohio and Ranger Schools such as State Forest Ranger School of the School of Forestry, University of Florida, Lake City, Florida.

Fire Lookouts: they usually serve as lookouts in fire towers in western forests.

Personal qualifications include a good general physical condition, initiative, resourcefulness, strong sense of responsibility, an honest and fair attitude, interest in the outdoors and a conviction in the importance of resource management. One must be able to stand loneliness know how to fight small fires, know how to cook their own food and have good eyesight.

Sources of further information are the National Arborists Association, P.O. Box 426, Wooster, Ohio and Ranger Schools such as State Forest Ranger School of the School of Forestry, University of Florida, Lake City, Florida.

UNIT IV

GEOLOGY

The reasons for studying geology are three-fold:

a. The pupil gains an understanding of how the earth's present shape and distribution of mineral resources came to be.

b. The pupil becomes acquainted with various occupations which require a knowledge of geology and learns how this knowledge is used in the occupations.

c. The pupil learns how we can live with nature, helping it to help us rather than exploiting it.

ACTIVITIES

No. of Activity

1 List the forces which tend to lower the earth's surface.

Possible list:

a. Weathering

1) Mechanical

2) Chemical

3) Biological

b. Erosion

1) Water

2) Wind

3) Ice

c. Faulting

2 List the forces which tend to elevate the earth's surface.

Possible list:

a. Deposition

b. Faulting

c. Rebound

d. Volcanism

3 List those things which tend to change the physical and chemical structure of the soil and rocks.

Possible list:

a. Heat (volcanism)

b. Rate of cooling (crystallizations)

c. Gravity (separation by density)

d. Leaching

e. Oxidation

4 Use of Rocks

Examine buildings (including your own school building) and places where natural rocks have been used for construction purposes. You should find such natural rocks as marble, granite, limestone, lannon stone and slate.

List the various occupations that were used in the construction of the building.

Following the list of suggested films and filmstrips are more careers related to geology.

The following activities are based on the above lists:

5 Expansion with Freezing of Water

Fill a narrow-necked bottle with water. Place the bottle in a freezer and observe how freezing breaks the bottle. This illustrates how freezing of water in cracks in rocks breaks them and moves them slightly.

6 Mechanical Rock Weathering

Wash and dry a small amount of gravel. Weigh the washed and dried gravel accurately. Place the gravel in a rock tumbler for one week. Wash and dry the gravel and weigh again. Note the percentage of loss in weight due to the mechanical bumping of the gravel together in the tumbler. This illustrates the mechanical weathering of rocks bumping each other in streams, wind blown sand, etc.

7 Chemical Rock Weathering

Put a piece of limestone in a beaker of water. Add a small amount of HCl. Observe the chemical destruction of the stone. This illustrates the chemical destruction of limestone by the H_2CO_3 in ground water, forming caves, etc.

8 Rusting of Iron

Place a clean nail in water. After several days observe the rust. Note how easily the rust is flaked off. Let the pupils note how crumbly some sandstone is. Connect these two ideas with chemical weathering by oxygen in the air.

9 Stream Table--Streams

Set up a stream table with sand and flat stones. Tilt the table slightly and allow a small stream of water to run down the table. Observe the changes in the course of the stream - meanders, Ox-bows, falls and rapids. Make the same observations with the table tilted at different angles.

10 Stream Table--Ground Cover

Use two stream tables, one with bare soil, the other with ground cover such as grass but both having the same kind of soil.

Elevate one end of each table slightly both the same. Sprinkle the same amount of water from a sprinkling can on each table. Observe the effect of ground-cover or a lack of it on erosion.

11 Stream Table--Erosion

Set up a stream table with sand in only two-thirds of the table. Have the empty end slightly lower. Make a groove lengthwise in the sand. Pour a measured amount of water down the groove and observe the amount of material carried by the stream. Note which is eroded the most, the bottom or sides of the stream. Tilt the table at different angles and make the same observations noting the differences resulting from the different stream drops.

12 Erosion

Measure the width and depth of a small gulley or rivulet before and after a heavy rainfall. Note the amount of erosion.

13 Stream Sediment

Collect measured samples of water from various streams and from different parts and depths of the streams. (Weigh your cleaned and marked sample bottles before collecting samples). Dry the samples thoroughly and weigh them. Calculate the amount of material carried by the streams.

The above can also be done during normal and flood time to determine the difference in amount of material carried by the same stream during these times.

14 Stream Table--Wind Erosion

Set up a flat stream table with a mixture of various grades of dust and sand. Have an electric fan blow across the table. Note the erosion caused by the wind.

15 Stream Table--Sedimentation

Tilt a stream table slightly and fill as nearly full as possible with water. Take a glass or 250mm beaker and half fill with a graded mixture of sand, clay and silt. Fill the container the rest of the way with water and mix well. Pour this down the table and note how it separates and settles according to the size of the particles. Not which settles first, second, etc. Connect this with the formation of conglomerate, sandstone, shale, etc.

16 Sedimentation

Fill a large beaker one-third full of a soil. Fill the rest of the beaker with water. Mix well and allow the mixture to settle for twenty-four hours. The layers formed normally are (from top to bottom) organic material floating, water, silt, clay and sand. The type of soil can be determined by the proportion of each layer. This simple test can be used to determine what type of plants are best suited to that particular soil. Example: roses grow best in a sandy soil.

17 Effects of Freezing Water Pushing

Use a tumbler that tapers considerably from bottom to top. Fill the tumbler with water and place in a freezer. Observe how the ice pushes up and out of the tumbler as it forms. This

shows how ice forming on ponds, lakes, etc. pushes up onto the shore, moving rocks, shells, etc. ahead of it.

18 Maximum Earth Slope

Make a pile of soil, another of sand, another of gravel, etc. until each starts tumbling. Measure the angle made by the tumbled material with the base. This angle is important to construction engineers, builders, etc. when cutting into hillsides, cutting ditches, etc. because any angle greater than that determined by this test for the particular material being cut into will cause severe landslides.

19 Soil Load Bearing Test

Place a one-half inch dowel stick endwise on a sample of soil. Put a given weight (about ten pounds) on top of the stick. Measure the depression made by the stick. Repeat this with samples of other materials such as sand, clay, etc. and determine the load that the material can carry. This is important to builders for determining the kind of footing they need for construction.

20 Transport Fine Particulate Through Coarser Particulate

Fill a beaker two-thirds with gravel. Cover with a layer of sand and silt. Pour water on this material and observe the transport of it through the gravel to the bottom of the beaker. Connect this with the settling of silts to form beds of clay. Also connect this with leaching to form mineral deposits such as the iron deposits of Minnesota.

21 Model--Folded Mountains

Place several layers of various colors of modeling clay on top of each other. Push on the ends of the model to demonstrate the folding and cracking of sedimentary rocks in folded mountains.

22 Crystal Size and Depth of Formation

Measure the size of the crystals in several pieces of granite and determine which formed at the deepest level. Larger crystals formed deepest.

23 Igneous Rock differences

Place a piece of pumice rock on top of a piece of obsidian rock on top of a piece of granite rock. Have the pupils note the differences between the three kinds of rocks. Since all three are made of the same material in the same proportions, guide the pupils to an explanation for the differences.

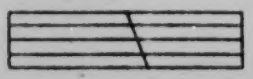
24 Model--Volcano

Make a working model of a volcano using about a half teaspoonful of ammonium bichromate placed in a mound on an asbestos mat. Light the tip of the mound with a match and then turn out the lights in the room. The result is a very realistic looking miniature volcano.

25 Model--Faulting

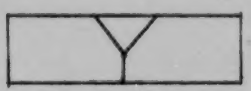
Paint various colored stripes lengthwise on the side of a block of wood about ten inches long, three inches wide and three inches high. Cut the block across the painted side at an angle so the two resulting blocks are beveled. Placing these blocks with the bevels together and sliding the one

block up or down show how faulting results in a displacement of sedimentary rocks on each side of the fault.



26 Model--Rift Valley

Paint a block as above but instead of cutting it in a bevel make a Y cut in it. Then, when pulling the two side blocks apart the V piece will settle, illustrating the formation of a "Rift" valley such as the Jordan Valley in the Holy Land.



Suggested Field Trips

1. Visit a local small stream such as "West Fork" stream in Mt. Airy. Note the angle of the tumbled sedimentary rocks in the stream (shows direction of flow). Note the steepness of the sides (indicates the rate of flow). Note the way the banks are cut on the inside and outside of the curves. Note undercut trees. Look for tree roots growing into cracks in rocks (Biological weathering).
2. Cincinnati Nature Center - take a trip along the stream to note forms and rates of erosion, sedimentary rocks, ripple marks in flagstone rocks in stream bed and fossils. Also a trip to fields is suggested to show properly and improperly cultivated land with resulting kinds of erosion or lack of it.
3. Look for fossils in Clifton Hill, Newport Shopping Center Hill, hill behind shopping center at Ashtree and Hamilton.
4. Look at the Chio River valley (Middle aged river valley) from Mt. Echo Park.
5. From "Fair View Park" observe the wide, old Licking river (Tease river) valley cut into the Illinois Glacial deposit. Observe the present, narrow Mill Creek Valley cut into the Wisconsin Glacial deposit which filled the Licking River valley. Looking south, note the old plane (top of the hills) into which the streams including the Licking River have cut valleys, forming hills.
6. Local sand and gravel quarries - note bedding of sand, size and shape of gravel and its origin (glacial or river), ripple marks, direction of flow of ancient streams and evidence of ancient flood and drought.
7. Natural History museum cave.
8. Hunting reserves and farms - erosion control.

Selected References

1. Accredited Curricula - Engineering
   Annual Reports of Engineers' Council for Professional Development, 29 West 39th St., N.Y. 18, N.Y.

2. After High School - What?
   Engineers' Council for Professional Development, 29 West 39th St., N.Y. 18, N.Y.

3. Engineering - A Creative Profession
   Engineers' Council for Professional Development, 29 West 39th St., N.Y. 18, N.Y.

4. Engineering as a Career: Ralph J. Smith
   McGraw-Hill Book Co., 330 West 42nd St., N.Y. 36, N.Y.

5. Economics of the Mineral Industries
   The Seeley W. Mudd Series, American Institute of Mining, Metallurgical and Petroleum Engineers (1959)

6. Mining Engineering - A Career in Coal
   National Coal Association (1959) Coal Building, Washington, D.C. 20006

7. Should You Go into the Mineral Industry? John W. Vanderwilt, New York Life Insurance Co., New York, N.Y.

8. Beiser, Arthur and Germaine. 1959 Our Earth. E. P. Dutton & Company, Inc., New York.

9. Hoffman, Arnold. Free Gold. Rinehart.

10. Joralemon, Ira B. Romantic Copper. Appleton-Century.

11. Lyman, George D. Saga of the Comstock Lode. Scribners.

12. Metcalfe, June. Mining Round the World. Oxford University Press

13. Metcalfe, June. Copper, The Red Metal. Viking.

14. Metcalfe, June. Aluminum from Mine to Sky. McGraw-Hill.

15. Rickard, T. A. Romance of Mining. Macmillan.

16. Wolfe, et al. 1966. Earth and Space Science. D. C. Heath & Co.

17. Earth Science Curriculum Project. 1967. Investigating the Earth. Houghton-Mifflin Co.

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19. Brandwein, et al. 1970. The Earth: Its Changing Form. Harcourt, Brace & World.

20. Marple, Mildred Fisher, & Brown, Walter C. 1958. Handbook for Teachers of Earth Science. Information Circular No. 15. Columbus, Ohio: Ohio Division of Geological Survey.

21. May, Julian. 1959. There's Adventure in Geology. Popular Mechanics Press, Chicago.

22. Namowitz, Samuel & Stone, D. 1969. Earth Science - 4th Ed. American Book Co.

23. Richards, Horace. 1959. The Story of Earth Science, Rocks, Fossils, Minerals Lippincott Company, Philadelphia.

24. Schneider, Herman. 1952. Rocks, Rivers and Changing Earth. William R. Scott, Inc., New York.

25. Sevrey, Irene. 1958. The First Book of the Earth. Franklin Watts, Inc., New York.

26. Wyler, Rose, & Ames, Gerald. The Restless Earth. Abelard-Schuman, Publishers, New York. n.d.

27. Zim, Herbert S. 1953. What's Inside the Earth. William Morrow & Company, Inc. New York.

Suggested Films

17	Birth and Death of Mountains
18	Our Changing Earth
20	What's Under the Ocean
61	Oceanograph: Science of the Sea
90	Yellowstone: Our First National Forest
164	Why do We Still have Mountains
168	Erosion - Leveling the Land
181	The River Valley
211	Rocks that Reveal the Past
275	Rocks that Form on the Earth's Surface
278	Evidence for the Ice Age

279	The Beach (A River of Sand)
561	The Enduring Wilderness
741	Geology of Yellowstone
1049	The River
1112	The Work of the Atmosphere
1113	The Work of Rivers
1114	Ground Water
1115	Geological Work of Ice
1143	The Earth's Rocky Crust
1145	The Work of Running Water
1454	What is Soil
1528	The Seashore
1541	River of Ice
1568	Pompeii and Vesuvius
1685	How Volcanoes Make Mountains
1702	Geysers and Hot Springs
1901	Understanding Our Earth: Glaciers
1905	Face of the Earth
1907	Rocks and Minerals
2011	Yosemite National Park
2038	Fossils are Interesting
2063	Understanding Our Earth: How Its Surface Changes
2152	Earthquakes and Volcanoes
2301	Treasures of the Earth
2344	Project "Mohole"
2395	Journey into Time
2681	Fossil Story

Filmstrips

6369	Story Fossils Tell
6389	Desert Rocks and Minerals
6846	Continents and Oceans
6864	How We Think the Earth Came to Be
6865	Our Earth is Changing
6866	How Rocks are Formed
6867	The Story of the Earth We Find in the Rocks
7206	Relief and Elevation
7278	The Seashore: A Continually changing Environment

Exhibits

(Suitcase) -	From Education Center
200.19	What is a Mineral
40.1	Plant Fossils and Living Relations

Sources of free and inexpensive materials for Geology:

1. Careers in Exploration Geophysics. Society of Exploration Geophysicists, 810 Shell Building, Tulsa, Okla. 74119. 1953. 16 pp

2. Careers in Geology, by Robert Shosteck. B'nai B'rith Vocational Service, 1640 Rhode Island Ave., N.W., Washington, D. C. 20006. 1957. 15 pp. 35¢.

3. Careers in Geophysics, by Don R. Frifield. B'nai B'rith Vocational Service, 1640 Rhode Island Ave., N.W., Washington, D.C. 20006. 1955. 6 pp. 35¢.

4. Employment Outlook for Geologists, Geophysicists, and Meteorologists. Bulletin 1255-33, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D.C. 20025. 1960. 11 pp. 10¢.

5. Geologist, by Warren Brackett and H. Alan Robinson. Personnel Services, Inc., P.O. Box 306, Jaffrey, N.H. 1956. 5 pp. 25¢

6. Information Concerning the Broad Field of Geophysics. American Geophysical Union, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005. 10 pp.
A description of those sub-sciences related to the problems and the processes of the earth and its environment in space. These include: geodesy, seismology, meteorology, geomagnetism and aeronomy, oceanography, volcanology, geochemistry, petrology, hydrology, and tectonophysics. --The organization has numerous other publications which will be supplied upon receipt of a specific outline of the correspondent's interests.

7. Opportunities in Geology and Geological Engineering, by Alfred K. Smelgrove. Vocational Guidance Manuals, Inc., 212-22 48th Ave., Bayside, N.Y. 11364 1960. 86 pp. $1.65.

8. Shall I Study Geological Sciences? American Geological Institute, 2101 Constitution Ave., N.W., Washington, D. C. 20025. 12 pp.

9. Should You Go Into the Mineral Industry? by John W. Vanderwilt. New York Life Insurance Co., Box 51, Madison Square Station, New York, N.Y. 10010. 1956. 11 pp.

10. Vocational and Professional Monographs: No. 60, Cartography (Map Making), by Hubert A. Bauer. Bellman Publishing Co., P.O. Box 172, Cambridge, Mass. 02138. 1957. 32 pp. $1.00.

Careers Related to Geology

Geologist: Studies composition, structure and history of earth's crust, examines rock, minerals and fossil remains to identify and determine sequence of processes affeecting development of earth. Applies knowledge of chemistry, physics, biology and mathematics to explain these phenomena and to help locate mineral and petroleum deposits and underground water resources. Studies ocean bottom. Applies geological knowledge to engineering problems encountered in construction projects. Studies fossil plants and animals to determine their evolutionary sequence and age.

Petroleum Geologist: Explores and charts strategraphic arrangement and composition of earth to locate gas and oil deposits. Studies well logs, analyzes cores and cuttings from well drilling and interprets data obtained by electrical or radioactive well logging and other subsurface surveys to identify earth strata. Examines aerial photographs and evaluates results of geophysical maps and didagrams.

Tectonophysicist: Studies elastic deformation of flow and rupture of constituent materials of earth's crust and makes deductions concerning forces causing these deformations. Studies formation of strata underlying continents and ocean beds, forces at work in earth's crust and general structure of coastal layers. Work is mostly research and findings applicable to prospecting.

Geomagnetician: Sets up magnetic observations and stations to chart earth's magnetic field. Applies data obtained to problems in field of telephony, telegraphy, radio broadcasting, navigation, mapping and geophysical prospecting.

Geodesist: Employs surveying and geodetic instruments such as transits, theodolites and other engineering instruments in setting up and improving network of triangulation over earth's surface in order to provide fixed points for use in making maps. Establishes bench marks. Performs gravimetric surveying to determine variations in earth's gravitational field and provides data used in determination of weight, size and mass of earth.

Mineralogist: Examines, analyzes and classifies minerals, gems and precious stones; isolates specimen from ore, rocks or matrices. Makes microscopic examination to determine shape, surface making and other physical characteristics. Performs physical and chemical tests and makes x-ray examinations to determine composition of specimen and type of crystalline structure.

Geomorphologist: structural geologists - Studies form of earth's surface and forces, such as erosion, glaciation and sedimentation, causing changes in land formation.

Geodesists Seismologist: Works at fixed locations throughout globe and studies courses and phenomena of earthquakes, using special devices and machines, including seismograph. Establishes existence of active fault lines or areas where earthquakes have occurred and near which it would be hazardous to build cities, dams, or lofty structure.

Volcanologist: Studies occurrence, origin and activity of volcanoes, origin of igneous rock and ore-forming processes occurring in earth in presence of igneous rock. Performs duties of studying ore bodies that may be commercially exploitable.

Geophysicist: Studies physical aspects of earth including its atmosphere and hydrosphere. Investigates and measures seismic, gravitational, electrical, thermal and magnetic forces affecting earth. Utilizing principles of physics, mathematics and chemistry, analyzes data obtained to compute shape of earth, estimate composition and structure of earth's interior, determine flow pattern of ocean tides and currents, study physical properties of atmosphere and help to locate petroleum and mineral deposits. Investigates origin and activity of glaciers, volcanoes and earthquakes, compiles data to prepare navigational charts and maps, predict atmosphere conditions and establish water supply and flood control programs.

Civil Engineer: Engages in the planning and design of works connected with transportation by railroad, highway, waterway or air, including railroad, highway and street location, bridges and other incidental structures, canals, rivers, piers, and harbors, terminals and airports. A great deal of constructional methods and procedures needed. Professional training beyond a Bachelor's degree is usually needed.

Associated careers to civil engineering: construction, bridge, railroad, municipal, hydraulic, sanitary, highway, water-supply, labor and architectual engineers.

Agricultural Engineer: Concerns himself with the development, upkeep, and most efficient use of agricultural machinery, farm structure, farm power and soil and water control. Professional training usually goes beyond the Bacherlor of Science degrees.

Associated careers: irrigation engineer, drainage engineer, forestry engineer and animal husbandryman.

Farmer: Works or manages the growing of plant crops on land. He may also specialize in the marketing of livestock. He should have knowledge of farm finance and farm economics. Some farmers have a bachelor's degree in agriculture.

Logger: Must cut down and prepare timber to be sent to a mill or plant. Must have a great deal of knowledge of trees and timberland. A high school degree is usually needed as well as a good background in agriculture.

Mining Engineer: Concerns himself with the efficient extraction of useful mineral substances from the earth's crust. Work ranges from the searching for and exploration of new ore bodies, through planning their exploitation by suitable methods and guiding the production of the mineral substance, to the processing of newly mined mineral material into commercially acceptable forms. Professional training beyond a bachelor's degree is usually needed.

Associated careers to mining engineering: ore dressing, petroleum, quarry and tunnel engineers.

Mine Workers: Specialists such as powdermen who handle explosives, muckers and drillers who work in the benches or stopes and timbermen who work to keep the mine from caving. Trammers move the ore to shafts and hoisters carry it to the surface. Other personnel also work with these men. A high school degree is of some importance.

Topographer: Calculates latitude, longitude, angles, areas and other information for map-making from field notes secured by engineering survey party, using reference tables and calculating. Plans, directs or

conducts surveys of land areas of such size that shape and size of earth exerts sufficient influence on survey measurements to require use of special high-accuracy techniques including astronomical observations and complex computations to compile data used in preparation of geodetic maps and charts.

Agriculture Economist: He works only in special sections of marketing of livestock. Employment is with the State Department of Agriculture. For further information contact USDA Recruitment Representative of land grant colleges or the U. S. Department of Agricultural Economics. The job requires extensive training in economics, statistics, marketing and farm finance.

UNIT V

LIVING THINGS

Topic A - A Study of Humans

ACTIVITIES

No. of Activity

1 Identifying the Parts of the Cell

Gently scrape the inside of your cheek with a clean toothpick to remove a film of surface cells. Spread the material into a thin smear on a clean microscope slide. Put a drop of iodine stain on the smear. Let the stain remain for a few minutes and then wash the slide with water. Then, place a cover glass on top of the stained part and examine the cells with a microprojector or microscope. Make a drawing of the different shapes of the cheek cells and label the nucleus, cell membrane, cytoplasm and vacuoles.

Repeat the same activity with blood cells and Wright's stain.

LIVING THINGS - SENSES

2 Taste in Humans

Wipe a pupil's tongue with a clean towel. Using a medicine dropper, place drops of sugar solution on different parts of the tongue. Can he taste sugar better on some parts of the tongue than on other parts? Wipe the tongue dry and repeat the test with salt solution and lemon juice. Make a drawing of the tongue and label the parts most sensitive to these three tastes.

3 Smell in Humans

Blindfold a pupil and have him carefully close his nostrils with his fingers. Then have him taste small pieces of apple, carrot, onion and potato. How many can he identify? Now remove the fingers and repeat the test. Explain how the sense of smell is used in tasting food.

4 Hearing in Humans

Blindfold a pupil and have him sit in the center of the room while the rest of the class is seated quietly around the walls of the room. Have him cover one ear and then move a loud-ticking alarm clock around the room. Can he determine the exact direction the clock is from his ear? Repeat the experiment, this time using both ears. Can a person determine the direction of sound better with one ear or with both of his ears? Can you explain the reason for this?

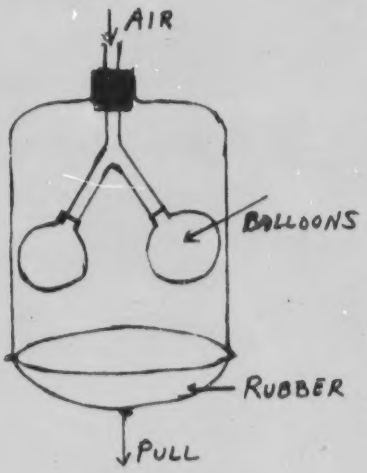
5 Sight in Humans

Obtain hog or cow eyes and dissect them, showing the different structures and presenting their function. Have pupils make drawings comparing eyes to a camera. (See worksheet 5a). Also, make diagrams to show the eye disorders that cause near-sightedness and farsightedness.

6 Breathing in Humans

Set up an apparatus like the one shown. Attach two small balloons to the ends of a Y-tube. Put the Y-tube into a bell jar and fit the tube into a one-hole stopper. Then, fit the stopper into the top opening of the bell jar so that no air

leaks into the jar. Now attach a piece of sheet rubber to the bottom of the bell jar. Be sure the rubber is tight so that no air leaks in or out. The sheet of rubber represents your diaphragm and the balloons represent your lungs. Push up on the sheet rubber. What happens to the balloons? Next pull down the piece of sheet rubber. What happens this time?



7 Pulse Rate and Breathing Rate

See worksheet 7a

8 Tobacco Harms Our Breathing System

See worksheet 8a

9 Care of the Skin - the Use of Soap to Remove Oil

See worksheet 9a

10 Food Releases Heat Energy When Digested

Put one end of a straightened paper clip through a peanut, brazil nut, or cashew and apply a lighted match to the nut. The nut will burn, giving off heat energy. Pour some melted butter or cooking oil into a small saucer and place a piece of soft string in the butter or oil, with one end of the string protruding above the liquid and hanging over the side

of the saucer. After the string has become saturated with the butter or oil, apply a lighted match to the end of the string. The string will act as a wick, and the butter or oil will burn for some time. Point out that when foods are digested in the body, they give off heat energy.

11 The Digestive Tract

See worksheet 11a

12 Digestion - Mouth

See worksheet 12a

13 Digestion - Stomach

See worksheet 13a

14 Digestion - Small Intestine

See worksheet 14a

15 Nutrition - Body Use of Food

See worksheet 15a

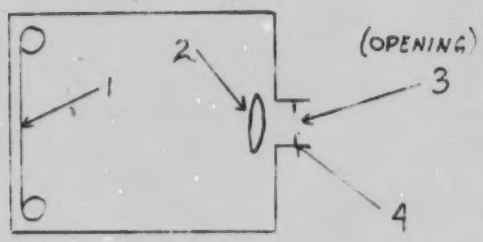
WORKSHEET 5a

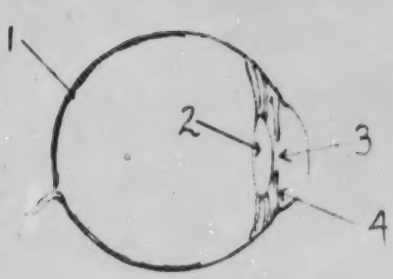
NAME _____

DATE _____

DIRECTIONS:

Name the parts that do the same work:





	1	2	3	4
Camera	_____	_____	_____	_____
Eye	_____	_____	_____	_____

WORKSHEET 7a

NAME _____

DATE _____

Pulse rate and breath rate after activity

Time Trials - One Minute	Number of Heart Beats
Trial Number One (1)	_____
Trial Number Two (2)	_____
Trial Number Three (3)	_____
Trial Number Four (4)	_____
Trial Number Five (5)	_____
	Total:

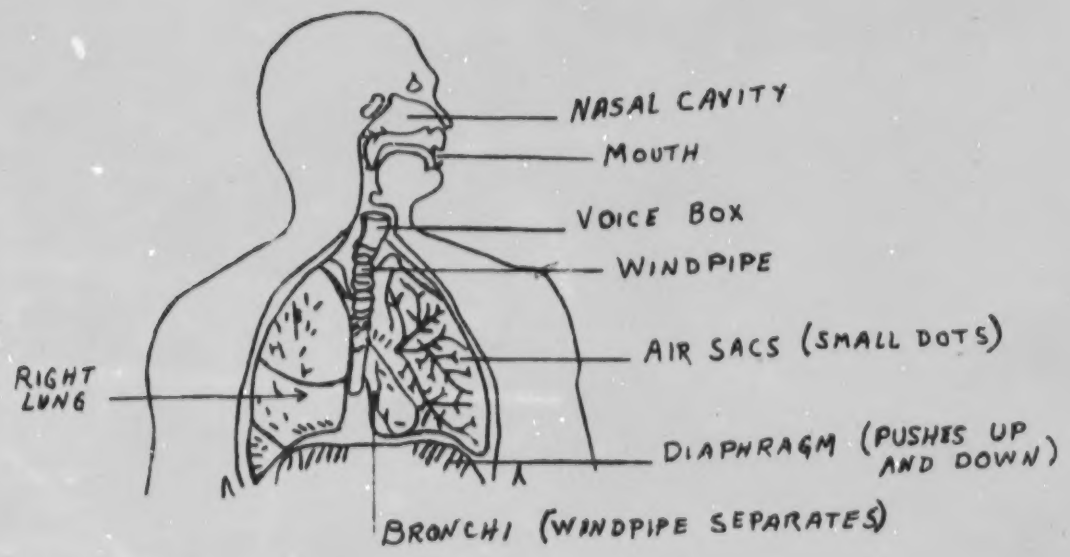
Time Trials - One Minute	Number of Times Your Breathe
Trial Number One (1)	_____
Trial Number Two (2)	_____
Trial Number Three (3)	_____
Trial Number Four (4)	_____
Trial Number Five (5)	_____
	Total:

Take Total _____

Divide by Five (5) Average _____

WORKSHEET 8a

Tobacco Harms Our Breathing System No.____



TOBACCO

In every puff of smoke, there are poisons. These poisons cause the heart to beat faster and often cause bad effects on the breathing system. Besides poisons, tobacco smoke sometimes makes the linings of the throat and lungs sore and red. It may also cause diseases of the throat and lungs. An example of a poison found in tobacco is NICOTINE.

Why do people smoke? People smoke because of cutoms, nervous habit and sociability. A lot of young people smoke because their friends do.

Effects of Smoking:

a.) Reduces the age of a person (If you smoke, your life is shortened)

b.) Increases heart beat

c.) Causes breathing system to be red and wore

d.) Causes irritation of the lungs

QUESTIONS:

1.) Have you ever smoked a cigarette? _____

2.) What are some poisons found in tobacco? _____

3.) What is found in every puff of smoke? _____

4.) What do tars in tobacco smoke sometimes do? _____

5.) Why do people smoke? _____

6.) What are some of the effects of smoking? _____

_____

7.) What does the diaphragm do? (see diagram) _____

_____

8.) Should one smoke? Tell me why or why not! _____

_____

_____

_____

WORKSHEET 9a

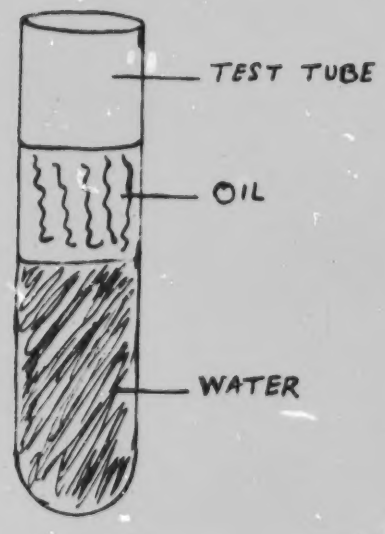
Care of the Skin

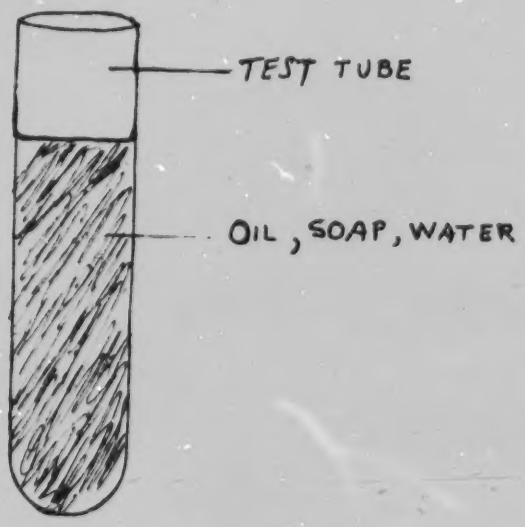
Use of Soap--Remove oil from skin

What to mix

In one test tube we mix oil and water.

In the other test tube we mix oil, soap, and water





1. Do oil and water mix? _____

2. Do oil, soap, and water mix? _____

3. After adding dirt, which became the dirtier - oil and water or oil, soap, and water? _____

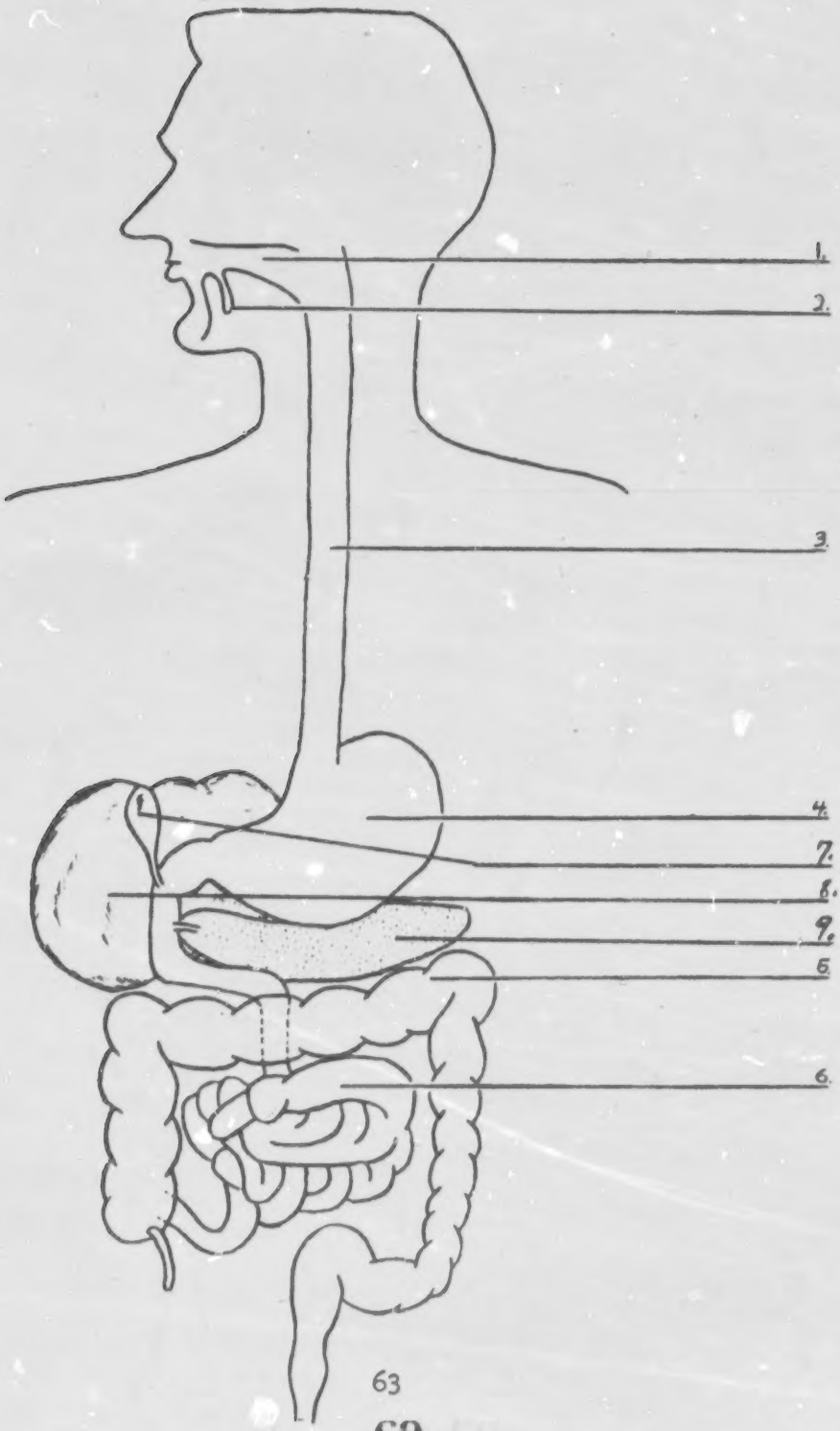
4. What two glands are found in the skin? _____

5. How does soap clean the skin? _____

WORKSHEET 11a

NAME _____

DATE _____



WORKSHEET 12a

DIGESTION _____ MOUTH

NAME _____

DATE _____

The mouth, which is a kind of chopping box, begins the process of getting food ready for use by the body. In this chopping box there are two rows of white teeth. The teeth break up food into small pieces when chewed.

The front teeth are called the cutters or incisors. They have sharp edges and cut the food into smaller bits. Next to these cutters are teeth with sharp points: these are called bicuspids. They help cut and tear the food into pieces. Toward the back of the mouth are teeth with flat tops. These are called grinders, or molars. They grind the food into still smaller bits.

In the mouth is a liquid called saliva which wets the food and makes it more easily swallowed. In the saliva is a material called ptyalin which helps change the starch to sugar. The longer food is kept in the mouth, the better it will digest.

After food is swallowed it goes town a tube called the gullet, or esophagus. This tube is about ten inches long and an inch across.

Questions

1. Fill in the correct names for the three kinds of teeth:
   Cutters _____
   Pointers _____
   Grinders _____
2. What is there in saliva that helps the starch change to sugar?
3. What are two names for the food tube?
4. How long and how wide is the food tube?

WORKSHEET 13a

DIGESTION _____ STOMACH

NAME _____

DATE _____

When food gets to the stomach it is ready for about one hour of mixing. The stomach may be pictured as a mixing bowl, with a lot of muscles moving the bowl back and forth. These muscles squeeze the food and push it from side to side. Food is mixed with a liquid or juice called gastric juice. In this juice there are two materials, one called pepsin and one rennin. The pepsin helps get the protein into a liquid. The rennin gets the protein out of the milk that we drink. Hydrochloric acid in the stomach helps make some of the food more easily digested.

Use the above to answer the following questions:

1. What is it in the stomach that squeezes food?

2. What is the name of the juice that is found in the stomach?

3. What two materials are in the juice?

4. Why is hydrochloric acid present in the stomach?

5. Can you name one enzyme found in the stomach?

6. Can you find the meaning of the word enzyme?

WORKSHEET 14a

DIGESTION - SMALL INTESTINE

NAME _____

DATE _____

From the stomach food goes down in a long tube called the small intestine. This organ is about twenty feet long and one inch across. If we could see the small intestine it would look something like a folded hose. There are three important liquids working within the small intestine: the bile, pancreatic, and intestional fluids.

The pancreas is a fish-shaped gland, six to nine inches long and it is found behind the stomach. This gland from cattle is eaten as food called sweet-bread. From this gland flows the pancreatic juice which contains insulin, which helps the body use sugar. The bile is made in the liver but is stored in the gall bladder. The gall bladder is a small pear-shaped sac attached to the underside of the liver. The bile neutralizes acids and emulsifies fats. After contact with the pancreatic juice, the bile and other intestional juices in the small intestines the food is digested and is ready to pass through the walls of the small intestine and into the blood stream to be carried to all parts of the body.

There are always some parts of the eaten food which cannot be changed into a liquid form. This undigested food is called waste material and goes to another long tube called the large intestine or colon. It generally takes the waste materials from twelve to twenty-four hours to pass through this large tube.

1. How long is the small intestine?
2. What are the names of the three juices which work in the small intestine?
3. Where can the pancreas be found?
4. What important material is found in the pancreatic juice?

NAME _____

DATE _____

5. Where is bile made?
6. Where is the bile stored?
7. What does bile do to fats and acids?
8. Where does the food go after it is digested?
9. How long does it take for food to pass through the large intestine?
10. What does insulin help the body use?
11. What is the name for undigested food?

WORKSHEET 15a

NUTRITION - BODY USE OF FOOD NAME _____

DATE _____

Nutrition

Nutrition is the process by which living things take in food and use it. All living things must have food in order to stay alive. Simple plants can be nourished by air, water, and sunshine; human beings have more complicated needs. They must rely for food either on plants or on animals which change plants into food which the body can use.

Purposes of Food

Our food serves three (3) main purposes:

1. It serves as fuel to furnish energy for work and play and to keep the body warm.
2. It furnishes the materials for body repair and growth.
3. It provides substances which keep the body in good working order--substances which, in other words, regulate body processes.

Malnutrition

Poor nutrition, commonly called malnutrition, is the result either of eating too little food or the wrong kind of food. Serious diseases attack people who do not have enough to eat; children may grow slowly or not at all; they may develop bowed joints and enlarged bone joints; the skin may become dry, flaky, and rough. People suffering from malnutrition may have decayed teeth, inflamed eyes and dry hair. They are likely to be tired and too often suffer from nervous disorders. Not all of the above symptoms occur in one person; the combination of symptoms depends on which foods are lacking from the diet.

WORKSHEET 15a (Continued)

NAME _____

DATE _____

Even in areas where food is plentiful entire families may suffer from malnutrition because of poor eating habits. On the other hand, one member of a family with good eating habits may be poorly nourished because he selects food unwisely. But eating the proper food is only one requirement for good nutrition. Fresh air, sunshine, exercise and rest are needed in order to make the best use of food.

QUESTIONS:

1) What is nutrition?

2) What is malnutrition?

3) List the three (3) purposes of food.

4) What happens to your bones if one does not eat properly?

5) What happens to your teeth if one does not eat properly?

6) What happens to your skin and hair if one does not eat properly?

Topic B - Animals and Plants

Sub-topic 1 - Insects

ACTIVITIES

No. of Activity

14 Insects

We are familiar with common animals such as the cat, dog, and horse. But there are other animals which perhaps we do not even realize are animals. These are the INSECTS.

While many insects are harmful, other insects are of use to us. Some insects produce products which are valuable. The SILKWORM is one of these useful insects. These worms give off a substance which hardens to form soft, silken threads. This silk is spun at the rate of six inches per minute. The worm can spin about 1,000 feet of thread in approximately three days.

Another valuable insect is the HONEYBEE. These bees make honey for themselves. Man has found this honey to be a delicious food. There are many interesting things to learn about bees. As bees gather NECTAR from flowers of plants to make honey, their bodies pick up a material like dust, which is called POLLEN. The bees take this pollen from one flower to another, thus helping the flower produce seeds - a very valuable service to the plant world. In some flowers, the RED CLOVER for example, the nectar is too far down in the flower for the tongues of ordinary bees; only the BUMBLE BEE can reach this nectar. This fact makes the bumble bee an important insect; only it can transfer the pollen of flowers such as red clover.

Another insect, the LADYBIRD BEETLE, is helpful to fruit growers. It attacks and eats small insects which suck the sap of fruit trees, causing them to die. Some time ago fruit growers in California brought a number of these beetles all the way from Australia to kill sucking insects.

There are many other insects which destroy harmful insects, and in so doing help man.

QUESTIONS TO BE ANSWERED

1. Are insects animals? Yes ____ No ____
2. Are all insects harmful? Yes ____ No ____
3. The silkworm is a helpful insect because /_____

   _____ _____
4. The silkworm makes silk at the rate of _____ inches per _____.
5. The silkworm can make _____ feet of thread in about three days.
6. The honeybee is a valuable insect because _____

   _____
7. The dust which is picked up on the body of the honeybee as it goes from flower to flower is called _____.
8. This transfer of dust by the honeybee helps plants produce _____.
9. The honeybee cannot gather nectar from the red clover plant because it does not have a long _____ _____ _____.
10. Only the _____ bee can gather nectar from the red clover.

77

11. The ladybird beetle helps people who grow _____.

12. Fruit growers get this beetle from _____.

13. The ladybird beetle attacks insects which _____

_____ _____ _____.

14. The sweet substance which bees get from flowers is called _____.

15. Two kinds of bees are _____ and _____.

16. Bees make honey to use as _____.

15 Mount and Display Insect

Insects should be mounted as quickly as possible. Otherwise they dry out and their bodies become brittle and break easily when handled. If the insects do become dry before they can be mounted, place them in a jar containing moist blotting paper and keep the jar covered for 24 hours. In this way the insects will be softened enough so that they can be handled easily. Insects such as flies, grasshoppers, and beetles can be mounted directly from the killing bottle. Use either common pins or regular mounting pins purchased from a scientific supply house. To mount an insect, insert just one pin through the chest or thorax a little to the right of the center line of the body. Straighten the legs, antennae, and wings as they dry. Invite an entomologist to visit the class and discuss insects.

16 Insects - Body parts

Collect several different insects, or see if you can borrow an insect collection. Study the insects to find the parts of their bodies. How can you tell one part from another? Draw pictures of several of your insects and label the body parts.

17 Life Cycle of the Fly

Place a small piece of raw, lean meat in a jar containing an inch of soil. Punch tiny holes in the lid of the jar. Catch several live flies and put them in the jar. If you get enough adult flies, some of them may lay eggs. Then you can watch the life cycle of the fly. Keep the jar in a warm dark place. Add a few drops of water to the jar each day. Watch for the larva, the pupa and the adult fly stages.

18 How Does a Fly Get Its Food

Place a sheet of glass five or six inches over the edge of a table and hold it in place by a heavy weight. Put a small amount of sugar on the extending glass plate and about two to three inches from the outer edge. Catch two or three live flies and put them under a beaker inverted over the sugar. Now you can look up through the glass plate and watch the flies eat. Describe how a fly eats sugar.

19 Insect Activity and Temperature

Catch several live insects. Place them in a jar. Punch a few small holes in the lid. Place the jar of insects in your refrigerator for half an hour. Remove and examine the insects. What happens when they are brought back into a warm room? Describe their change.

Sub-topic 2 - Plants

20 Studying Bacteria

Expose a prepared Petri dish to bacteria in the air by removing the cover for 15 minutes. You can try different places with a number of different dishes. These places might include different areas of the classroom, the halls at passing time, the playground, etc. Replace the cover after the exposure and paste a label on the dish to identify the place where it was exposed. Leave the dish in a warm, dark place for several days. On examination do you see little colored spots forming on the agar? Where did you find the greatest number of micro-organisms in the air?

21 Plant Growth and Light

Plant two pots with two or three bean seeds. Allow one pot to grow in darkness and the other in sunshine. Observe the differences.

22 Slide Preparation from Cultures

It is rather simple to prepare bacteria slides from your own culture. No microtechnique is necessary. A sample procedure is as follows:

1. Wash slide with soap and water.
2. Add one small drop of distilled water.
3. Heat platinum wire before and after using.
4. With loop of platinum wire, take a tiny bit of bacteria from the culture and add this to the drop of water on the slide.

5. Smear gently with loop.
6. Pass slide through heat several times to fix the bacteria. Use colorless Bunsen burner flame.
7. Add a drop of stain - methylene blue or safranin - and wait for a few minutes.
8. Wash off with water.
9. Dry around the stain and pass the slide through a flame.
10. Place a small drop of immersion oil on the stain and examine with the oil immersion lens.

23 Field Trip - Mosses, Ferns, and Liverworts

Take a field trip to collect specimens of mosses, ferns, and liverworts. Examine the specimens with a hand lens and a microscope for the sori and sporangia.

Identify and mount moss specimens.

Identify and mount fern specimens.

Make enlarged drawings of: A. the life cycle of mosses

B. the life cycle of fern.

Collect and sprout fern and moss spores.

24 Study of the Leaf

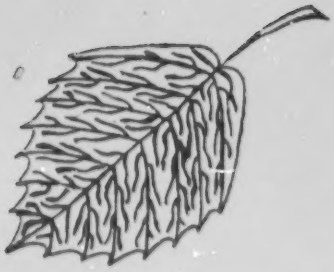
See worksheet 24a

25 Field Trip - Plants and Seeds

Plan a field trip to collect specimens and seeds of gymnosperms and both sub-classes of angiosperms. (If flowers and seeds cannot be found, dried specimens may be used.)

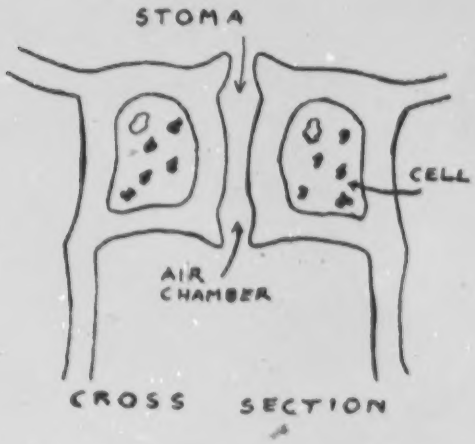
WORKSHEET 24a

Let Us Study the Leaf



The body of the leaf is called the blade. The edge of the blade may be be smooth or irregular. The lines on a leaf are the veins and midribs. A stem holds a leaf to a branch. Can you locate these parts on the leaf you were given to examine? Write the words blade, vein, midrib, edge, stem in the correct places on the drawing of the leaf.

The leaf would be useless if it could not get supplies of carbon dioxide and water. Where do leaves get carbon dioxide? Leaves get carbon dioxide from the air around them. The average leaf has 125,000 tiny openings per square inch. These openings are stomata, from the Greek word meaning mouth. Through these stomata, gases come in and go out of the leaves. Inside the leaves are air spaces like little hallways, through which carbon dioxide goes to the food-making cells and extra oxygen comes away.



The water needed by the leaves cannot come to them through the stomata. It must come from the roots, whose tips are always reaching out to tap new moisture in the soil.

Plants have pipelines made of long, slender cells. These stretch from every root tip, along the roots through the stalks and stems, out through the veins to every part of the leaf.

All day long, while the sun is shining, leaves make starches and/or sugars from carbon dioxide and water.

Examine and compare these leaves, stems, flowers and seeds. Prepare microscope slides as well as fresh specimens.

26 Life Cycle of a Pine Tree

Prepare the life cycle of a pine tree (or another cone-bearer) and mount it. Secure some pollen and make a microscope slide. Mount cone, seed and a young tree (eight to ten inches tall).

27 Wood Collection

Make a wood collection from twenty trees. Cut pieces of trees four inches long and not over one inch or less than one-half inch in diameter; cut one end on an angle, starting one and one-half inches from the end and sloping to the center. Mount each and put its correct identification under it.

28 Garden Flowers - Monocot or Dicot

Make a list of ten or more common garden flowers and identify them as monodots or dicots and annuals, biennials, or perennials.

29 Foodgetting - Teeth, Beak, and Claws

Observe the teeth or beak and the claws of some of the following animals: chicken hawk, dog, cat, pig, cow, horse, squirrel, rabbit, goat and chicken. Wherever possible observe their eating habits. If you cannot observe live animals, collect pictures of them. Make a chart showing the ways the animals are adapted to foodgetting.

30 Birds - Legs and Feathers

If you have a chicken or a pet bird at home examine it. Bend the leg as the bird would do when it sits down. What happens to the toes when the leg is bent? How does this help the bird when it rests at night? Spread out a wing. How are the feathers arranged? How does their surface compare to their mass?

31 Animals - Survival

Make a three-column chart. List at least five animals in the first column of the chart. In the second column list the special body parts of each animal that helps it to survive. In the third column list the specially developed sense that helps the animals to live. See how many different and unusual examples you and your classmates can find.

32 Animals - Weather Protection

Make a two-column chart. In the first column list five or more different animals. In the second column list the way each animal protects itself against climate changes.

33 Practice in Using the Microscope

Materials: Microscopes - Prepared Slides

While the microscope is a precision instrument, it is a tool that we may use often if we use it correctly. Use will not wear it out, but incorrect use may damage or ruin it.

a. If the instrument must be carried, grasp it by the upright part of the frame with one hand, placing the other hand below the base. Should the microscope be dropped, it would be ruined.

b. Place the microscope on the table with the upright part of frame toward your chest.

c. Move the barrel upward and downward. Learn in which direction you must turn the barrel to move it in the direction you wish.

d. While looking through the eye piece, adjust the mirror so that light is directed through the instrument.

e. Practice looking into the microscope with both eyes open. This may seem difficult at first, but with practice the difficulty will disappear. You will find keeping both eyes open is better than closing one eye.

During this activity point out the various careers that use the microscope in their work.

34 Focusing the Microscope

Materials - Prepared Slides - Instruct the class that they will be using some of the techniques in this demonstration that are used in the following occupations: medical technologist, laboratory assistant, serologist, etc.

Procedure

Have the pupils place the prepared slide under the objective with the material to be studied directly over the hole in the stage. Focus the light up through the stage. Turn down the low-power objectives as close to the slide as possible without touching it. Then with the coarse adjustment turn the body tube slowly upward until the slide is in focus. In focusing it is often advisable to move the slide gently while raising the objective. When the slide is in focus it will be noticed that the slightest defects in the glass are noticeable. This will serve as a guide since at first it is difficult to place material to be studied directly in the field of vision. After it has been located in the center of the low-power field then the high-power objective may be revolved into place.

35 The Use of Lenses in Instruments

Have the pupils read about and report on the part lenses play in the function of such instruments as the camera, microscope, and telescope.

36 A Personal Project

List the public health regulations you can discover that affect you personally or your home. Check thoroughly on each of them to see whether you are conforming closely in every case.

37 Reports

Do some reference reading and report on the health department in your city or county, learning what it does and how it operates. (Visit clinics and laboratories).

38 Athletic Safety Checkup

Arrange to have a committee survey the school gymnasium and athletic fields and report in class all defective conditions that might cause accidents. This committee might also serve as a safety squad to inspect the facilities.

39 Industrial Medical Examinations

Find out whether an industry in your community gives medical examinations to applicants for work; whether it has a medical office employing full-time doctors and nurses and whether it expects employees to report any illness or injury at once.

40 Professional Athletics and Doctors

Find out whether a professional baseball team has a doctor with it constantly. Discuss other occupations that may be related to a professional baseball team.

41 Health Career Opportunities

Find out about career opportunities in health fields. Your school has a health career Guidebook published by the National Health Council, which described opportunities in 156 health occupations.

42 Health Work and National Agencies

Investigate the health work of the National Tuberculosis Association, the American Red Cross, American Cancer Society, American Heart Association, and other organizations for promoting health.

43 Health and Retirement

Make out a plan of how you would prepare yourself for retirement and old age, indicating health preparation, financial plans, and various forms of mental and physical creative hobbies that would be useful.

44 Studying Vocations

Try describing your dream job. Put it down on paper no matter how foolish it may seem to you. Then list all the vocations you can think of that use the same abilities. Select two or three vocations you think you would really like and make a study of them. Don't hurry your decision. You have a long life ahead of you and you want to be sure it's good.

Topic F - First Aid

This topic points out what techniques can be used safely by the first-aider and indicates some of the things that can be done to make the patient more comfortable until the doctor arrives.

ACTIVITIES

Refer to:

Potthoff - First Aid Textbook for Juniors. 1953. (and supplements). Doubleday, New York.

Selected References

Asimov, Isaac, The Chemical Life. New York: Abelard, 1954.

Best, C. H. and Taylor, N.B. The Human Body and Its Functions. New York: Holt, Rinehart & Winston, 1948

Bevans, Mitchell H. The Book of Sea Shells. New York: Doubleday, 1969.

Crosby, M.D., Edwin L. and Committee. Health Careers Guidebook. Washington, D.C.: U. S. Government Printing Office.

Forrester, Gertrude. Occupational Literature, an Annotated Bibliography. New York: H. W. Wilson Company, 1953.

Glenser, Bernard. All About the Human Body. New York: Random, 1958.

Parker, Bertha M. Community Health. New York: Harper, 1949.

Poole, Lynn and Gray. Scientists Who Work Outdoors. New York: Dodd, Mead and Company, 1961.

Shepard, W. P. Essentials of Public Health. New York: Lippincott, 1962.

Turner, C. E. Personal and Community Health. Chicago: Mosby, 1948.

Pamphlets

Health and Hygiene. Superintendent of Documents, Washington, D. C. 20402

Alcohol. American Business Men's Research Foundation, 53 West Jackson Boulevard, Chicago, Illinois.

Committee on Careers
National League of Nursing
10 Columbus Circle, New York, N. Y. 10019

Titles

Do you Want to be a Nurse
School Nurse
Nursing Careers in Mental Health
Nurse, Man

National Association for Practical Nurse
Education and Service
535 Fifth Avenue, New York, N. Y. 10017

Title

The Practical Nurse

American Dental Hygienists Association
100 E. Ohio Street, Chicago, Illinois 60611

American Physical Therapy Association
1790 Broadway, New York, N.Y.

American Psychiatric Association,
1700 18th St., N.W., Washington, D. C. 20009

Suggested Films

2157	Exploring Your Growth
12	Digestion in Our Bodies
2258	Life of Mold
2629	Health Careers No. 1
2631	Health Careers No. 3
2632	Health Careers No. 4
2208	A Visit to the Water Works
2201	This Our Town Transportation in Cincinnati
1591	What You Should Know About Biological Warfare
263	Breath of Life
1755	Checking for Injuries
2938	50,000 Lives
2161	First Aid, Part I
2162	First Aid, Part II

Filmstrips

6024	How Your Body Grows
6291	Kind of Cells
6974	The Eyes
6031	Your Blood System
6839	Bacteria

6459 Community Sanitation

6460 Community Diseases

6455 Safety in the Community

6385 Simple Nursing

6233 Dressing and Bandages Used in First Aid

6234 First Aid for Wounds

6236 First Aid in Common Emergencies

Slides

5290 The Zoo

Models

8094 Torso

8118 Heart

8100 Resusci-Anne

Health Career Information - Places to Write

1. On the Biological and Other Life Science (Health-Related Career)

   (a) American Chemical Society
   1155 Sixteenth Street, N.W.
   Washington, D. C. 20006

   (b) American Institute of Physics
   355 East Forty-fifth Street
   New York, New York 10017

   (c) American Society of Biological Chemists
   9650 Wisconsin Avenue
   Washington, D. C. 20006

2. On Dentistry

   (a) American Dental Association
   211 East Chicago Avenue
   Chicago, Ill. 60611

   (b) American Dental Assistants Association
   410 First National Bank Building
   La Porte, Indiana 46330

3. On the Environmental Health Field

National Association of Sanitariums
University of Denver
Denver, Colorado 80216

American Society of Civil Engineers
(Sanitary Engineering)
345 East Forty-Seventh Street
New York, New York 10017

American Hospital Association
(Hospital Engineers)
840 North Lake Shore Drive
Chicago, Illinois 60611

4. On Health Careers in the Armed Forces

(a) Medical and Health
Department of Defense
Washington, D. C. 20025

(b) American Association for Health, Physical Education and Recreation
1201 Sixteenth Street, N.W.
Washington, D. C. 20036

5. On Medical Libraries

Medical Library Association
Palmolive Building
919 North Michigan Avenue
Chicago, Illinois 60611

6. On the Mental Health Field

American Psychiatric Association
1700 Eighteenth Street, N.W.
Washington, D. C. 20009

7. On Orthotics and Prosthetics

(Design and Fitting of Artificial Limbs and Braces)

American Orthotics and Prosthetics Association
919 Eighteenth Street
Washington, D. C. 20006

8. On Public Health

American Public Health Association
1790 Broadway
New York, New York 10019

9. Microbiology

"Microbiology." The American Biology Teacher, Vol. 30, No. 6, August, 1968

Complimentary copy from:

Difco Laboratories
Detroit, Michigan 48201

Medical Librarian: The position requires a knowledge of medical literature and involves the selection of library materials, cataloging, compiling bibliographies and supervising assistants in non-professional procedures. Some librarians offer translating and abstracting services. Professionally trained librarians qualify for administrative positions in their specialty. Personal qualifications include high scholarship ability, ability to get along with people and have dignity, initiative, executive ability and imagination. Some library internships are available but advancement generally requires considerable training.

The demand for personnel far exceeds the supply for qualified librarians. Employment is in medical schools, medical societies, hospitals (including Army and Veteran's) and pharmaceutical firms. For further information contact the Medical Library Association, Inc., 919 N. Michigan Street, Chicago, Ill. 60611.

Medical Secretary/Assistant: The work includes secretarial duties such as answering the phone, making appointments, receptionist, handling the mail and sometimes answering routine correspondence. In many physicians' offices the secretary also manages the financial details of sending out bills, keeping track of payments, ordering supplies and many times prepares patients for medical examination.

Personal qualifications include that a person be intelligent, willing to assume responsibility, tactful, sympathetic and be able to get along with people; must be accurate, neat and a detailist.

Preparation includes high school graduation and subsequent training so that the individual can handle the duties in the office. These latter

include typing, mechanical transcription, shorthand (generally), filing, indexing, bookkeeping and a knowledge of medical terminology.

Employment is in the physician's office, hospital, or clinic. There is a constant demand for highly trained medical secretaries. Advancement possibilities depend on the employer and relate closely to the employee's efficiency and dependability. Further information can be secured from Indiana Health Careers, Inc., 1100 West Michigan Street, Indianapolis, Indiana 46207.

Medical Record Technician: This person supervises the medical record department in a small hospital under the direction of the medical record committee and the administrator. In larger hospitals the medical record technician will be a senior clerk in the medical record department.

Personal qualifications include typing proficiency and a good command of the English language. Entrance requirements generally include high school graduation and this is followed with on-the-job training which may include some formal classes.

There is a great shortage of technicians. Employment opportunities are in hospitals, extended care facilities (nursing homes), doctors' offices and other health agencies. A source of further information is Executive Director, American Association of Medical Record Librarians, 840 North Lake Shore Drive, Chicago, Illinois 60611.

Medical Record Librarian: This person is responsible for departmental organization and management and the completeness and accuracy of medical records. She assists in setting and maintaining standards for medical records; codes diseases and operations; maintains disease, operation, physician and patient indices; abstracts medical records; prepares statistics; assists physicians in reasearch; and attends certain medical staff meetings.

Personal qualifications include tactfulness, patience and persuasiveness; good judgment and executive ability; good sense of humor; an interest in science; and an ability for detailed work.

Training following high school graduation, generally includes extensive formal supervised training concurrent with classroom instruction during the latter stages.

Employment opportunities are in hospitals, clinics and public health agencies. For further information contact the American Association of Medical Record Librarians, 840 N. Lake Shore Drive, Chicago, Illinois 60611.

Nurse Aides: A nursing aide may be male or female and works under the direction of a professional nurse (RN), contributing directly to the welfare of the patients. An aide may make beds, bathe patients, assist in feeding patients, deliver messages, escort patient to other departments, distribute diet tray and perform other duties which are important to patient care. A male aide, sometimes called an orderly, may be asked to do heavier work in a nursing unit, such as lifting a patient or moving and setting large pieces of equipment.

Nurses aides and orderlies are trained on the job in hospitals, nursing homes and other patient-care facilities. Training programs usually are three months long and consist of classroom instruction, demonstration and practice, and are generally taught by RN's.

Ward Clerks: Ward clerks are essential and basic hospital workers. They are sometimes called floor clerks or station clerks because they work in the nursing stations on hospital treatment floors. They act as receptionists and do much of the paper work for their nursing station.

Personal qualifications include persons who are gracious and pleasant, have some business courses in school, are accurate in spelling and arithmetic, and are able to type.

Hospital OJT (on the job training) for ward clerk usually lasts five weeks. While you will work continually with patient records and help direct visitors to patients, you will have little actual contact with patients themselves.

Ward clerks earn more than aides and orderlies and frequently are promoted from those ranks.

Electrocardiograph and Electroencephalograph Operators: Since electronics has become important in diagnosis, two new kinds of careers have developed. The first device, usually called an ECG, records the delicate electrical action of the heart. The ECG is used to find heart disease and to record the progress of a patient recovering from a heart condition. The EEG, or electroencephalograph, is a device which records brain waves.

Because she or he works closely with patients, a good nature and sympathetic personality is desirable.

You can become an ECG or EEG technician after three to six months OJT under a heart or brain specialist or an experienced technician.

Marine Biologist: Career Related to Living Things

Studies plants and animals living in water and environmental conditions affecting them: Investigates water temperature, acidity, light, oxygen content and other physical conditions to determine their relationship to aquatic life. Examines various types of water life, such as plankton, worms, clams, mussels and snails. May specialize in the study of salt water aquatic life and be designated Marine Biologist; or fresh water aquatic life and be designated Limnologist.

Careers Related to Living Things

Non-professional positions

Careers	No. in Field	Annual Need	Length of Training	Men	Women
Ward Clerk	Unknown	Growing	5 Weeks	Yes	Yes
Nursing Aide	400,000	20,000	3 Months		Yes
ECK Technicians	Unknown	Unknown	3-6 Months	Yes	Yes
Occupational Room Technicians	Unknown	Growing	3 Months	Yes	
Occupational Therapy Assistant	853	Growing	3-6 Months	Yes	Yes
Licensed Practical Nurse	265,000	30,000	1 Year	Yes	Yes
Medical Assistant	Unknown	Growing	1 Year	Yes	Yes
Histologic Technician	3,000	2,000	1 Year	Yes	Yes
Dental Assistant	Unknown	Growing	OJT		Yes
X-Ray Technician	65,000	3,000	2 Years	Yes	Yes
Medical Technologist	43,000	2,000	3 Years	Yes	Yes

UNIT VI

ENERGY

Energy, that which is responsible for all change, has to be one of the most important subjects studied when preparing for any career. Even to prepare a balanced meal, to go on a diet, to reduce the fever of a sick child or lift a heavy object without injury to oneself, something must be known about energy. Energy causes change and without change there is nothing for us, not even life.

ACTIVITIES

No. of Activity

1 Is Energy Matter

In a darkened room shine the beams of two or more flashlights (each beam colored different) through each other. Record your observation of their interference with each other. This illustrates that energy does not occupy space, showing the main difference between energy and matter.

2. Forms of Energy

List the seven forms of energy on the chalkboard and have the pupils list examples of how each form is used. Then have the pupils give examples of how energy can be changed from one form to another. Discuss various occupations that use this knowledge.

3 Potential Energy

Hold a book above a table. Drop the book. Record your observation. Point out that the book is no different when held above

the table than when lying on it. The energy stored "in the book" is really in the gravitational field and not in the book. Without gravity there would be no falling book and no mechanical energy. Give other examples of the same thing such as the energy stored in the water behind a dam is really stored in the gravitational field and not in the water. This is also one illustration that all forms of energy are secondary in the universe and are really one or more of the three basic forces of the universe in action.

4 Energy Related to Motion

Define energy as "the ability to do work" or "the ability to produce motion in matter." Point out that unless energy produces a change in motion of something we have no way of knowing that it exists.

5 Standing Wave

Have two pupils hold the ends of a long extension cord or window rope, stretching it tightly across the room. Pull down on the cord at one end and release it. Have pupils record their observation. The wave that passes along the length of the cord is only the energy wave, not molecules running from one end of the cord to the other.

6 Compressional Waves

Stretch a slinky across the marking surface of an overhead projector. Disturb the slinky so as to produce compressional waves. The pupils can again see that what moves from one end of the slinky to the other end is an energy wave and not the molecules of the slinky.

7 Heat Absorption by Glass

Take a large square of colored glass and another of plain glass, both of the same temperature. Have pupils feel that both are the same temperature. Then place the pieces of glass so sunlight passes through each for half an hour. Then have pupils feel the pieces of glass. This experiment illustrates that when energy is absorbed it is changed into heat.

8 Radiation Detection

If possible obtain a Geiger counter or other type of radiation detector. Bring a wrist watch or alarm clock with a luminous dial near the detector and note the increase in the number of clicks or in the reading. Some of the pupils' mineral collections will have a sample of an uranium ore that can be tested with the detector. Have the pupil read and report on other methods and instruments used to detect radiation. List related careers.

9 Controlling Nuclear Energy

Obtain pictures, draw diagrams or construct a model of nuclear reaction. Discuss the parts of the reactor, their functions and method of controlling the rate of fission. Make a list of the actual and potential uses for nuclear reactor. Discuss careers that use this knowledge.

10 Radioactivity

Obtain a magnifying glass and wrist watch or alarm clock that has a luminous dial. Go into a completely darkened room and wait until your eyes become completely accustomed to the darkness.

Hold the dial a few inches from one eye and adjust the distance until you see tiny burst of flashes of light being given off from the number and hand of the dial. Now examine the phenomenon under the magnifying glass. Point out that the hand and numbers of the dial are coated with a paint that contain a material, such as zinc sulfide, and a tiny amount of radium compound. The radium compound breaks up, giving off invisible radiations that strikes the zinc sulfide and make it give off these tiny bursts of flashes of light. Each burst of light represents the breaking up of one radioactive particle of the radium compound.

Suggested References

Books from the public and school libraries:

Azimov, Isaac. Building Blocks of the Universe. Abelard

Barrow, George. Your World in Motion. Harcourt, Brace & World

Branley, Franklyn M. Solar Energy. New York: Crowell, 1964.

DeCamp, Lyon S. Man and Power. Golden Press

Esterer, Arnulf K. Your Career in Chemistry. New York: Julian Messner, 1964

Freeman, Ira M. All About the Atom. Random House

Freeman, Mae and Ira. The Story of the Atom. New York: Random, 1960.

Hogben, Lancelot. The Wonderful World of Energy. Doubleday

Luhr, Overton. Physics Tells Why. Ronald

McCormick, Jack. Atoms, Energy and Machines. Creative Education Society. Creative Science Series.

Montgomery, Elizabeth R. Keys to Nature's Secrets. Dodd

Morgan, Alfred P. Boy's Book of Science and Construction. Lothrop

Pollack, Philip. Careers and Opportunities in Physics. New York: Dutton & Co., 1961

Posin, Daniel Q. What is Energy? Benefic

Ruchlis, Hyman and Lemon, H. B. Exploring Physics. Harcourt, Brace & World.

Suggested Films

7	Forces
59	Moving Things on Land
64	Making Things Move
75	Fatal Meeting
2069	Energy
2237	Matter (Laws of Conservation of Energy)
2401	Gravity: How it Affects Us
2667	Engineering Career for Tomorrow
1423	Atomic Energy
1592	Atomic Alert

UNIT VII

WORK

If no work is done, nothing is accomplished. This truth is basic and should be learned early in life. We get nothing for doing nothing. To get something, work must be done. When work is done, a change in motion necessarily occurs, and it is this change which makes everything happen that happens. To prepare a balanced meal, to reduce the temperature of a sick child, to move a mountain, to pick up a heavy object without injury to oneself, or to do anything, we need to understand work.

ACTIVITIES

No. of Activity	
	<u>Difference between Work and Energy</u>
1	a. Write the definition of energy on the board. (energy: the ability to do work.) Underneath this write the definition of work. (The changing of the motion of matter.) Rewrite the definition of energy under the other two definitions. (Energy: the ability to change the motion of matter.)
	Have a large pupil lean against the wall. Question the other pupils as to whether a force is being applied to the wall, energy is being used, or work is being done on the wall. This demonstration shows that: (1) force is the basis of energy (2) energy can be used without work being done (3) a change in motion must occur for work to be done.

b. Have the pupils hold a book at arm's length. Using the definitions on the board, again question the pupils about a force being applied. (Point out that forces must always be in pairs, opposing each other.) Is energy being used? (the pupils' arms will become tired.) Is work being done? (For practical purposes no change in motion occurs, therefore no work is being done.)

2 Measuring work

Have the pupils weigh several objects such as a book, a block of wood, etc., in pounds and grams, recording their observations. Have the pupils measure the height of their tables in feet and centimeters. Record this on an appropriate form. Then, have the pupils express the work required to lift the objects from the floor to the table top in both foot pounds and gram centimeters. Discuss these units of work at this point. The mathematical definition of work can be given at this time. "Work is a force moved through a distance", or "Work = Force x Distance".

3 Machines that help man with his work.

List and define on the board the six simple machines that help man with his work. Using a relatively simple but still a complex machine like a bicycle, point out that even complex machines are only combinations of the six basic, simple machines. (DO NOT TELL THE PUPILS THAT THESE MACHINES DO NOT ALLOW THEM TO GET SOMETHING FOR NOTHING, NAMELY A GREATER WORK OUTPUT THAN INPUT. THEY SHOULD DISCOVER THIS BY EXPERIMENT.)

4 The Lever - work input equals the work output

Have the pupils place a meter stick balance on several books on their table so the horizontal meter stick is ten to twelve inches above the table. The fulcrum should be in the middle of the meter stick. Using a pair of matched spring scales, one hooked at each end of the meter stick, pull down slightly on one of the spring scales while holding the other one still. Record the force on each scale.

Next, holding meter sticks vertical on the table at each end of the lever, move one end of the lever a measured distance and observe the distance the other end moves. Record and multiply the force times the distance at each end of the lever.

Repeat all of the above but with the fulcrum 333 mm from one end of the meter stick lever. (One lever arm is thus twice as long as the other.)

Repeat again but with the fulcrum at 250 mm (one lever arm three times as long as the other).

Have the pupils compare the work input with the work output in each case. They should discover that both are the same.

5 The Lever - three classes

With the meter stick balance in front of the pupils, have them find all possible position combinations of the effort, the resistance and the fulcrum. Diagram each of these on the board and label them according to their class. Have the pupils list examples of each class of lever in use.

6 Mechanical Advantage

Guide a discussion to lead the pupils to see that in all cases of the lever (except where the fulcrum was in the middle) the greater force always moved the shorter distance and smaller force moved the greater distance. This enabled them to overcome a great force with a small effort but the effort had to move through a greater distance than the resistance did. Or, they could make a small resistance move a great distance by applying a large effort over a short distance. In either case the work done at each end of the lever was the same. Point out that the ratio of the resistance to the effort is called the Mechanical Advantage of the machine. Have pupils determine the mechanical advantage when force is multiplied (a large resistance is overcome by a small effort) and when distance is multiplied (resistance moves farther than effort).

7 The Pulley - why it gives a mechanical advantage

Hook up a single fixed pulley system. Move the effort a measured distance and measure the distance that the resistance moves. Record both motions.

Hook up a system using one fixed and one movable pulley. Again move the effort a measured distance and measure the distance moved by the resistance. Record both distances.

Repeat without recording but with observation until you can explain the reason for the difference. Both ropes supporting the resistance must be shortened by the single motion of the effort, thus each shortens only half of the effort distance.

Using matched spring balances for the effort and resistance in each of the above systems, measure and record the effort required to overcome a given resistance. State the mechanical advantage of each system.

Repeat the above with a system having two fixed and one movable pulley. Determine the relationship between the mechanical advantage and the number of ropes supporting the resistance.

8 Industrial Pulley Systems

Give examples of pulley systems used in earth moving, demolition and construction equipment in aircraft and other uses.

9 The Inclined Plane

Fill a model truck with sand until the total weighs exactly one pound. Place one end of a four foot long board on blocks or books until it is exactly one foot higher than the other end. With a spring scale measure the effort required to move the truck up the inclined plane. (Move the truck very slowly). Determine the mechanical advantage (resistance over effort) and from this determine how you would find the mechanical advantage of an inclined plane from the length of the plane and its height.

Repeat the above experiment using different heights for the high end of the plane.

List uses of the inclined plane.

10 The Wedge

Have pupils determine, in a discussion, the relationship between the inclined plane and the wedge. Have them list possible uses of the wedge.

11 The Wheel and Axle

Use a large movie reel as a wheel and axle as follows: fasten a strong string through one of the holes in the outer edge of the reel; fasten another around the center, wrapping it several times; and support the reel on a pencil through the center hole. With spring scales fastened to the two strings, pull in opposite directions. Considering one spring scale as the effort, pull it with a measured force. Read on the other scale the resistance overcome by the effort. Determine the mechanical advantage.

Reverse the effort and resistance and again determine the mechanical advantage.

12 Uses of the Wheel and Axle

Have pupils list as many uses of the wheel and axle as they can. Stress these uses in transportation, in the cams of punch presses, valve lifters in engines, etc.

13 The screw

Examine some screws and determine of which of the other simple machines they are a special case. Cut a right triangle out of a piece of paper and make a heavy line with pen or pencil along the hypotenuse. Wrap this triangle around a pencil so the lined hypotenuse forms the thread of a screw and determine how to figure the mechanical advantage of the screw.

14 Uses of the Screw

Have the pupils list as many uses of the screw as they can. Be sure to include the screw-jack.

15 Friction - what it is

a. Use a six-inch long piece of two by four that is smooth on one side and rough on the other and having a hook in one end. With the smooth side down pull the block slowly over a rough board by means of a spring scale. Record the effort. Turn the block over so the rough side is down and repeat, again recording the effort. Determine what causes the difference in the efforts. This experiment illustrates the effect of friction.

b. Make a diagram on the board of a highly magnified piece of material showing its roughness and how this can cause a binding called friction.

16 Overcoming friction

Have pupils discuss and list ways of overcoming this friction.

17 Kinds of friction

a. Mesh the teeth of two gears and try to force the gears apart without allowing the gears to rotate. Record observations. Next, allow the gears to rotate and record the observations. In rolling friction the rough surfaces lift away from each other and do not have to bend or tear each other as in sliding friction.

b. Slide a block of wood across the table. Then roll a cylinder of the same kind of wood across the same table and record the results. Examine some ball or roller bearings such as skate wheels or auto wheel bearings.

18 "Frictionless" movement

Using a frictionless puck, demonstrate one way that an almost frictionless motion can be accomplished.

19 Power

Write the definition of power on the board and give its formula. Then, giving the pupils examples of work being done in certain periods of time, have them determine the power required.

Suggested Field Trips

Local construction site

The operation of cranes, bulldozers, power shovel and other heavy equipment can be seen in operation.

Local large plant

The operation of heavy equipment such as cranes, mules and large conveyor tables can be seen in use.

Local auto repair garage

Smaller, specialized equipment can be seen in use.

Local road building site

The operation of large earth movers and concrete layers as well as other equipment can be seen in use.

Suggested References

Books from the public and school libraries:

Adler, Irving. Tools in Your Life. New York: Day, 1956.

American Heritage. Men of Science and Invention. Harper

Barr, George. Research Ideas for Young Scientists. Whittesey House.

Barrow, George. Your World in Motion. Harcourt.

Blough, Glenn O. Doing Work. New York: Harper, 1959.

Cunningham, E. and Reed L. Guide to Earning a Living. Simon & Schuster.

Meyer, Jerome S. Machines. World Publishing Co.

Morgan, Alfred P. Boys' Book of Engines, Motors and Turbines. Scribner

Pratt, Fletcher. All About Famous Inventors and Their Inventions. Random House.

Suggested Films

7	Forces
59	Moving Things on Land
64	Making Things Move
66	Energy and Work
75	Fatal Meeting
493	Simple Machines - Work and Mechanical Advantage
1226	Simple Machines
1532	Energy in Our Rivers
1602	Principles of Frictions
1879	Wheels and Axles
1881	Inclined Planes
1882	Levers
2039	Machines that Move the Earth
2069	Energy
2092	We Use Power
2418	Friction and Its Effects

Filmstrips

6052	What is Horsepower?
6424	Modern Engines
6425	Putting Engines to Work
6464	Machines and Tools to Help Us Work
6537	The Generator
6605	Friction at Work
6752	Know Your Car
6979	Simple Machines

Sources of free and inexpensive materials:

1. B'Nai B'rith Vocational Service
   1129 Vermont Avenue, N.W.
   Washington, D.C. 20005

2. Chronicle Guidance Service
   Moravia, N.Y.

3. Vocational Guidance Manuals
   1011 E. Tremont Avenue
   New York, N.Y. 10060

4. Personal Services, Inc.
   Peapack, N.J.

5. Bureau of Labor Statistics
   U. S. Department of Labor
   Superintendent of Documents
   Government Printing Office
   Washington, D. C. 20025

Careers Related to Work

Bricklayers: with the use of many types of tools, constructs walls, chimneys, partitions etc. from brick or other masonry material.

Carpenters: with the use of many tools, erects wooden frames, forms, floors, stairways, etc.

Iron Workers: assemble, erect, or install structural metal products in construction of buildings.

All-round machinists: Shape metal parts by using hand and machine tools. Plan and make a variety of products.

Automotive mechanics: repair motors, bodies, chassis of cars, buses and trucks.

Millwrights: Dismantle, move, reassemble, install machinery, and other heavy equipment used in industry.

Tool and Die Makers: construct, repair, and maintain tools and dies used in shaping and forming metal parts.

Operators of large construction equipment: Operates equipment such as cranes, bulldozers and power shovel.

Operators of large plant equipment: Operate such equipment as cranes, mules and large conveyor tables.

UNIT VIII

HEAT

ACTIVITIES

No. of Activity

1 Performing an Experiment

Heat to boiling one cup of water in one container, and two cups of water in another container. Use the same size flame and the same size container for each. Check the temperature of the water in each container every 30 seconds. Prepare a graph to show how the temperature of water rose in each container.

a. In which did it go up more rapidly? Why?

b. In which will it go down faster?

Use your answers to these questions as a hypothesis. Test it by keeping a record of the temperature of water in each container as the water is cooling. Prepare charts and/or graphs to show your findings.

2 Conducting Additional Investigations

Make a list of the various tasks that you perform during the day. After each task, indicate whether or not it is work, as the scientist defines work. Tell the sources of energy used for each task. Tell where energy is changed from one form into another. Include tasks in which you use machines. Have pupils relate their tasks to an occupation.

3 How are vacuum pans used?

Pour a little water into a round bottom flask. Heat the water to boiling. Remove the flask from the flame and stopper the flask tightly. You may use a thermometer in the stopper to record the temperature changes. Turn the flask up-side-down and clamp into position on ringstand. Then dip a cellulose sponge in cold water and let the water from the sponge flow over the flask. Some of the water vapor inside will condense. This reduces the pressure on the surface of the liquid, and the water will start to boil vigorously.

The principle of boiling at reduced pressure is used in vacuum pans. Sugar crystals can be obtained from sugar syrup by boiling the syrup in a vacuum pan. The liquid evaporates quickly. At the low temperature used, there is no danger of scorching the sugar. Concentrated fruit juices, evaporated milk, certain drugs and dyestuffs are produced in a similar manner.

Chemical operators, chemical operator helpers and laborers use these principles in their work.

4 How to use heat to separate substances

Put a solution of corn syrup or molasses in a flask. Fit the flask with a one-hole stopper. Connect a piece of glass tubing to the flask. Connect a piece of clear rubber tubing to the glass tube and run it into a test tube. Heat the flask. As the syrup boils, water will evaporate and will condense in the cooler rubber tubing. This process is called distillation

and is used in many places in industry.

Engineers, chemical operators and operator helpers operate distillation equipment.

5 Demonstration of convection currents in air

By the use of a convection box, demonstrate how convection currents are set up in air by unequal heating. Heat is transmitted by the molecules in these moving currents. The gravity hot air heating system found in many homes work on this principle. The careers are numerous in the manufacture of these heating units. Also the sale, installation, and service of these heating units involve many careers.

6 Transforming one material to another with heat

Use a pyrex test tube fitted with a one-hole stopper and a short glass tube. Put some wood splints or some bituminous coal into the test tube. Heat the test tube with a Bunsen burner. As the test tube is heated, a gas will evolve from the short glass tube. As the gas is produced, the material in the test tube is converted to another substance. If wood was used, the final product will be charcoal. If coal was used, the product will be coke. Both of these materials have a market value. This process is called destructive distillation.

7 Demonstrating the bimetallic strip

Heat a bimetallic strip of iron and brass. As heat is applied the strip starts to bend because of the difference in the expansion of iron and brass. This principle is used in thermostats. A thermostat is an automatic device for regulating

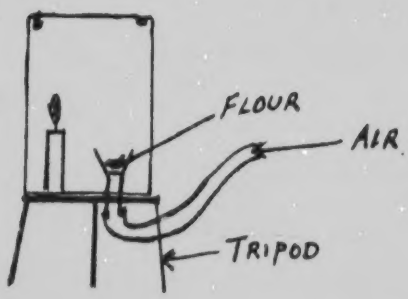
temperature, actuating fire alarms, controlling automatic sprinklers, etc. Many careers from engineers to production workers are involved in the manufacture of such instruments.

8 Spontaneous ignition

Carefully drop glycerin onto a small heap of potassium permanganate. Magnesium powder placed around the edge of the heap adds to the demonstration.

9 Dust explosion

Obtain a one-gallon, friction lid, can (clean paint can). Make a hole to one side of the bottom of the can and place a funnel through the hole. Attach a long piece of rubber tubing to the end of the funnel. Next, put a small amount of flour in the funnel, and place a burning candle at the opposite side of the can. Place the lid on the can not too tightly and blow a quick burst of air through the tubing to disperse the flour. A violent explosion results and blows the lid off of the can. Use caution with the experiment. Discuss how the activity relates to explosions in granaries and coal mines.



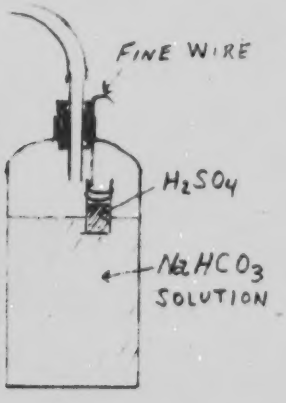
10 Extinguishing fires

Prepare carbon dioxide with marble chips and hydrochloric acid. Collect the carbon dioxide by water displacement. The carbon dioxide can then be used in the following experiments:
Thrust a burning splint into a bottle of CO_2. The splint goes out immediately. Pour the CO_2 into a bottle with a burning candle at its bottom. The candle goes out. Put out a kerosens fire with the CO_2. Use an evaporating dish with a small amount of water to create the kerosene fire.

Discuss the various ways carbon dioxide is used in fire fighting.

11 Constructing a soda-acid fire extinguisher

Obtain a small mouthed bottle and a one-holed rubber stopper to fit the bottle. Place a three or four inch piece of glass tubing in the stopper. Fill the bottle three-fourths of the way full with a solution of $NaHCO_3$. Suspend a small vial of H_2SO_4 from the stopper. When the bottle is inverted, the soda solution and the acid run together and react to form carbon dioxide.



The classroom fire extinguisher could be examined and compared with the demonstration model

Selected References

Billings, Henry. Diesel Electric 4030. New York: The Viking Press, 1950.

Ruchlis, Hy. Orbit: A Picture Story of Force and Motion. New York: Harper and Brothers, 1958.

UNESCO, 700 Science Experiments for Everyone. New York: Doubleday & Company, Inc., 1958.

Suggested Films

1710	Choosing Your Occupation	10 min.
1593	Fire Fighting for Householders	8 min.
1502	Drafts of the Fire	10 min.
1383	Heating and Air Conditioning	11 min.
1349	Looking Through Glass	20 min.
1259	The Sheet Metal Worker	11 min.
1252	The Inside of Arc Welding	10 min.
521	The Story of Heat	

Shell Oil Films: Shell Oil Co.
450 N. Meridian St.
Indianapolis, IN 46204

	Frontiers of Friction	18 min. color
	An Introduction to the Heat Engines	23 min. B/W
	The Diesel Story	19 min. B/W
	The Gas Turbine	15 min. B/W

Modern Talking Pictures Service
Garfield Place

Film: The Noble Breed (Life of firemen)

Filmstrips

6015 Community Workers

6058 Gas Pressure at Work

6219 Your New Job

Resources in the Community

Fireman: Contact Don Zwick, Captain, firefighters' representative
Available guest speakers, films
Telephone 661-7326

Many programs from the Cincinnati Gas & Electric Co.
Available speakers, films, tours
Contact Community Relations, 4th & Main, Cincinnati, Ohio 45202
Telephone: 632-2768

Free or inexpensive teaching aids and information:

1. Dietetics as a Profession. The American Dietetic Association, 620 North Michigan Ave., Chicago, Ill 60611. 36 pp. Single free copy to teachers.

2. Safety Posters - National Commission on Safety Education, National Education Association, 1201 16th St., N.W., Washington, D. C., 20036. 18" x 22". Single copies free to teachers.

3. Keep Your Home Free From Fire
Fire Safety Materials - National Fire Prevention Association, Public Relations Department, 60 Batterymarch St., Boston, Mass. 02110. Hundreds of items available. Single copies free. Write for publication list.

4. Educational Films and Safety Literature - Aetna Life & Casualty, Advertising Department (D-A), 151 Farmington Ave., Hartford, Connecticut 06115. Write for safety literature and request folder describing films on safety. Free films except for return postage.

5. Gas - American Gas Association, 605 Third Ave., New York, N.Y. 10016. Available free in most areas from local gas companies.

   - Experiments with Gas (N00080). 35 pp. Jr. High level.
   - Gas Serves Your Community (N00160). A cutout kit containing 28 pictures depicting the story of gas from the fields to the community.
   - How Your Gas Meter Works (N00100). A kit with illustrations and diagrams explaining the workings of a gas meter. Contains teacher's guide, chart, and 40 student handout sheets. Jr. high level.
   - Science in Action Series. Kits containing teacher's guide, one wall chart, 40 student handout sheets. Specify kit by number and name.

     Science Principles and Your Automatic Gas Range (N00170)
     Science Principles and Your Automatic Gas Water Heater (N00210)
     Science Principles and Your Automatic Clothes Dryer (N00250)
     Science Principles and Your Automatic Home Heater (N00290)
     Science Principles and Your Automatic Incinerator (N00380)

Careers Related to Heat

Blacksmith: This job involves making and repairing many different kinds of metal articles and machine parts used in forging automobiles and other industrial equipment by shaping, forming and welding together glowing hot metal.

A high school education or its equivalent is preferred. An important requirement is physical strength and stamina needed to pound metal into shape and to handle heavy parts.

This occupation is usually entered as an on-the-job trainee or as an apprentice.

Arc Welder: The arc welder joins or repairs metal using electric arc welding equipment. Intense heat and sometimes pressure is applied to melt the edges of the metal so that they fuse permanently.

Most employers prefer high school graduates in good physical condition with good eyesight and manual dexterity.

Successful completion of a training program is necessary before an individual can advance in the job.

Other types of welders include the gas welder, the atomic welder, the combination welder, the resistance welder operator, the oxygen cutter who trims metal, and the arc cutter who trims metal with an electric arc torch.

Boilermaking Occupations: Boilermaking involves three main crafts: boilermaker, layout man, and fitup man.

A high school education is required to enter an apprenticeship program for any of the three occupations mentioned above.

Boilermakers assemble and put into place the sections and fittings of boilers, tanks, vats, and similar equipment.

Layout men mark off dimensions on the metal plates from which the boiler sections will be formed.

Fitup men check the accuracy of the various parts of the boiler, tank, or other vessels after they have been cut and assembled. He checks to see that all specifications are met.

Fire Fighters: Firemen have the responsibility of protecting life and property from the danger of fire.

A high school diploma is required and in most cases, applicants must pass written tests on intelligence. Very rigid physical examinations are also required.

Fire Inspector: Inspects buildings to detect and eliminate fire hazards. These men also inspect fire-extinguishing and fire-protection equipment to insure they are in proper operating condition. These conditions are usually reported to the owner of the property for correction; if not corrected, these conditions must be reported to the proper authorities for correction.

Fire inspectors are often called upon to give speeches on fire prevention before school and civic groups.

Generally, firemen are appointed as inspectors.

Fire-Extinguisher Serviceman

This serviceman repairs and tests fire extinguishers in repair shops and in establishments, such as factories, homes, garages, and office buildings. He cleans the extinguishers and recharges them with materials such as soda water, sulfuric acid, and carbon tetrachloride. He also tests the extinguishers for conformity with legal specificiations, using special equipment.

He may even install cabinets and brackets to hold the extinguishers.

Fire Lookout: This watchman observes, locates, and reports forest fires and weather phenomena from remote fire-lookout stations. If a fire is sighted this man locates them on an area map, estimates its size, and quickly reports his findings to the base camp.

Airplane Mechanics: Airplane mechanics inspect, service, repair, and overhaul aircraft. They may work as line maintenance mechanics doing emergency repairs at the airport, or as overhaul mechanics doing major repairs and periodic inspections at the airline's main overhaul base.

The line maintenance mechanic is an all-around craftsman who must be able to make repairs on all parts of the plane. The overhaul mechanic may specialize in a particular phase of repair.

Working on parts of the airplane other than the engine is the job of the airframe or aircraft mechanic. The airframe mechanic inspects, overhauls, or services such parts as wings, fuselage, tail assembly, fuel and oil tanks, and landing gear.

A person interested in these occupations should include mathematics, physics, and shop courses in his high school education. After completing high school, there are three basic methods of entering this occupation: 1) completion of an apprenticeship program, 2) graduation from an F.A.A. approved school, or 3) through on-the-job training.

One advantage of this occupation is that mechanics and their families are entitled to a limited amount of free or reduced fare transportation on their companies' flights, depending upon the length of service.

Diesel Mechanics: Diesel mechanics repair and maintain diesel engines of trucks, buses, railroad trains, and other equipment. The work of the diesel mechanic will vary depending on whether he services automotive engines, marine engines, or railroad engines.

In his work, the diesel mechanic will use hand tools, surface gauges, pressure gauges, feelers and micrometers to check the wear of parts.

A diesel mechanic should be of average intelligence and have a degree of mechanical aptitude. During high school courses in mathematics, science, and shop should be taken. It is essential to be able to read with understanding, for a considerable amount of time is spent reading service manuals.

Most young men who become diesel mechanics first work on gasoline engines. An apprenticeship program provides the best means of becoming a diesel mechanic. A satisfactory performance on tests given by the state employment bureau is one of the prerequisites for consideration. Experience in a filling station or auto shop is also desirable.

Air Conditioning and Refrigeration Mechanics:

These mechanics install, maintain, and repair equipment used for conditioning air and cooling water on customers' premises.

A high school education is becoming a prerequisite for training in this field. Physics, chemistry, and shops should be taken during high school.

To qualify as an air-conditioning and refrigeration mechanic a person must complete either an apprenticeship or an on-the-job training program.

Asbestos and Insulation Workers: This occupation involves covering pipes, boilers, and other equipment to insure that either heat or cold will be retained. Therefore less fuel is used and the equipment works more efficiently.

A high school diploma is recommended but not required.

This trade is usually learned through a four-year, on-the-job training program with a journeyman.

Automobile Mechanics

Automobile mechanics service and repair mechanical, electrical, and body parts of cars, trucks, and other types of gasoline engines.

Most employers prefer a high school graduate with some understanding of automobile construction and operation.

A person entering this profession may take an apprenticeship or on-the-job training program.

UNIT IX

SOUND

ACTIVITIES

No. of Activity

1 Pitch (frequency)

Draw the edge of an index card over the teeth of a comb at different speeds. The faster the index card moves against the teeth, the faster it vibrates and the higher the pitch of the sound.

2 The Speed of Sound

Have the pupils report on the speed of sound in air, water and solids, such as wood and steel. Discuss the effect of temperature on the speed of sound and point out that increasing heat produces an increase in molecular motion. Point out that the audiologists are concerned with audibility, which is the degree or extent of a person's ability to hear. He uses electro-acoustic equipment to determine type and degree of hearing problems.

3 Use of Seismograph

Have the pupils report on the seismograph and how geologists use it in locating earthquakes and prospecting for oil deposits. Emphasize the importance of the various types of seismic waves in the use of the Seismograph.

4 Ultrasonic Sound Waves

Blow a dog whistle. Point out that our ears can only hear sounds within a definite frequency range. Point out that today

these ultrasonic sound waves can open garage doors automatically, clean tartar from teeth, kill bacteria, set objects afire, sterilize animals, help direct ships and aircraft and detect flaws in metal castings or automobile tires. Have pupils read and report on some of the above uses of ultrasonic waves.

5 Plan a Trip to the Greater Cincinnati Airport

Ask pupils to watch a jet plane as it is traveling. The sound of the plane will seem to be coming from a point in the sky behind the spot where they see the plane. Point out that light travels so much faster than sound that they may see the plane immediately. It takes more time for the sound to reach their ears. Have the pupils observe the various occupations offered by the airport.

The transportation of passengers and cargo by air requires a great many skilled workers to fly the plane, maintain and repair the equipment, provide services to passengers at terminals and during flight, and perform ordinary business services. The class may be divided into committees to report on the various duties of each occupation. For example:

Committee No. 1

Title: Flight Crews

Occupations
1. Pilots
2. Co-pilots
3. Flight Engineer
4. Stewardesses

Committee No. 2

Title: Ground Operational Personnel

Occupations
1. Dispatcher
2. Controllers
3. Meteorologist
4. Radio Operators
5. Teletypists

Committee No. 3

Title: Airplane Mechanics

Occupations
1. Line Maintenance Mechanics
2. Air Carrier Maintenance Inspector
3. Aircraft Inspector
4. Mechanic
5. Inspector
6. Lead Inspector

Committee No. 4

Title: Office Workers

Occupations
1. Business Machine Operator
2. Bookkeeping Machine Operator
3. Electronic Tabulating and Computing Machine Operator
4. Calculating Machine Operator
5. Secretaries
6. Stenographer
7. Typists
8. File Clerk
9. Teletype Operator

Committee No. 5

Title: Traffic Agents and Clerks

Occupations
1. Ticket Agent
2. Reservation Agent
3. Traffic Representative
4. Receptionist
5. Passenger Service Agent
6. Cargo Agent
7. Air Freight Agent
8. Information Clerk

Committee No. 6

Title: Occupations Offered by Other Corporations

1. Motel Services
2. Beauty Salon Job
   a.
   b.
   c.
3. Gift shop
4. Barbershop

6 Sound Waves are Logitudinal Vibrations

When sound waves move forward there is little forward motion of the air. Each compression transfers its energy to the air particles ahead of it. This fact may be illustrated by using collision balls. Raise the first ball and then let it fall against the others. Note that the impulse is transferred to each ball in turn until the last ball is reached. This ball flies out but the others remain stationary.

7 Demonstrate Resonance or Sympathetic Vibrations

Set up two resonating boxes with two tuning forks having the same frequency. Place the resonating boxes, with the open end toward each other, several feet apart. Set one of the tuning forks into vibration. After it has vibrated several seconds, touch the prongs to stop them. We now find that the tuning fork mounted on the other box has been placed into vibration. The sound waves produced in the air by the first vibrating tuning fork acted on the second fork in a regular fashion. This caused the second tuning fork to vibrate. Such action is called resonance.

8 Resonance in Tubes

Hold a vibrating tuning fork over a glass cylinder. Gradually add water to the cylinder until the water reaches the level at which the sound is loudest. (Closed resonant column = $\frac{1}{4}$ wave length.) The sound waves reflected by the water surface meets the direct wave produced by the tuning fork exactly in the same place of the waves. This causes the air column in the cylinder to vibrate sympathetically or to resonate with the tuning fork. A more intense sound results. An open resonant column = $\frac{1}{2}$ wave length.

9 Demonstrate the Interference of Sound Waves

If we sound two tuning forks, as an example, having frequencies of 256 vibrations per second and 260 vibrations per second simultaneously, we will hear 4 beats per second. The number of beats may give us an unpleasant effect or sound, or they may give us a pleasant effect or sound. If beat is unpleasant, we say that it is discordant. If the beats are pleasant, we say that the tones produce harmony. Musicians try to produce beats which are pleasant and thus produce harmonious tones.

10 Demonstrate Visible Sound Waves on an Oscilloscope

The sound waves to be "seen" are first transformed by a microphone into electrical impulses. These impulses trace a visual pattern on the fluorescent screen of the oscilloscope.

11 Demonstrate Musical Instruments

Have pupils bring several different musical instruments to class. Have them demonstrate and explain how the sound is produced in the

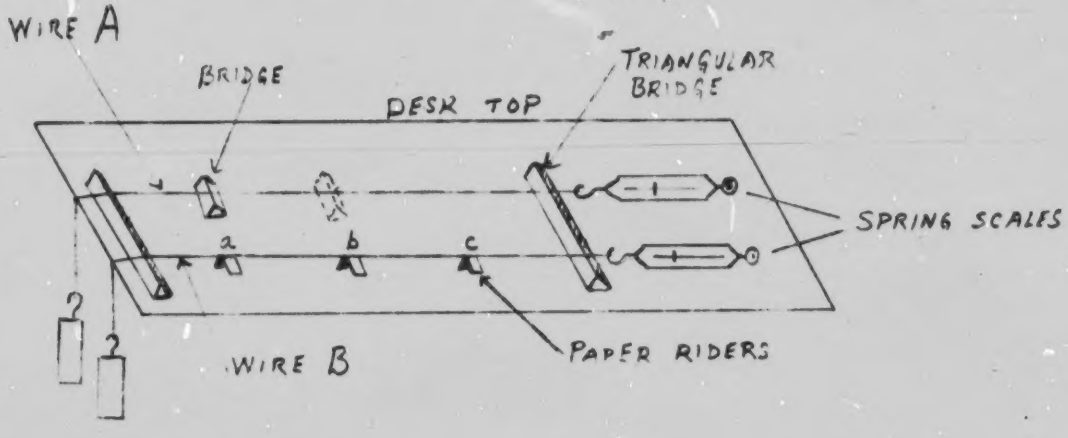
individual instruments and how the pitch is altered.

12 Demonstration "telephone"

A "telephone" can be made with a piece of string stretched between the bottoms of two tin cans. The string may be as long as 100 feet or more. Ask pupils to explain how the model works and in what ways it is similar to the telephone.

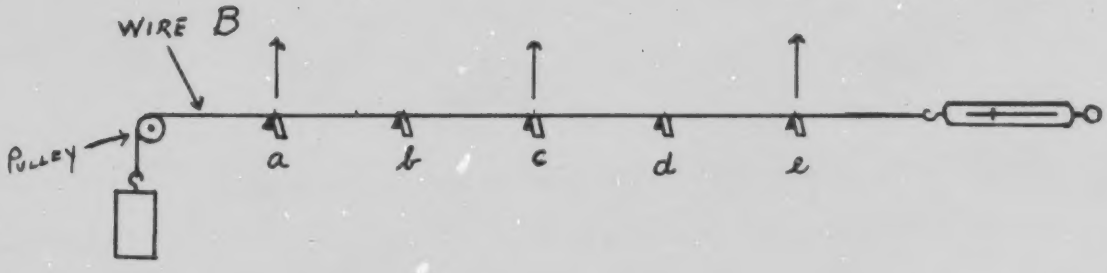
13 Harmonics and Quality

Construct a sonometer with two wires of the same size, material, and length, and stretched so as to produce the same frequency tone. Because of safety, it is better to use gut strings such as those for the violin, cello, etc.



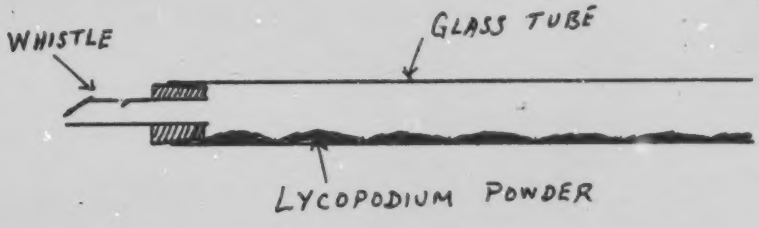
Part I - Place a bridge under the middle of Wire A, so that each of its segments produces a tone one octave above that of B. Now place three paper riders on B in positions a, b, c, and pluck A at the middle of one of its segments. The fact that rider a and c are thrown off while b remains, shows that B vibrates in two segments sympathetic with Wire A.

Part II - Place the bridge one-third of the distance between the ends of A. Next put five paper riders equidistance along wire B. Riders a, c, and e are thrown off when wire A is plucked.



The experiment shows there was no vibration at points b and d. Discuss harmonics and overtones with the class and ask them to explain how the experiment shows a wire can produce overtones.

Part III - Air columns also produce overtones by vibrating in segments.



Sprinkle lycopodium powder evenly inside of a glass tube with a whistle attached to one end. Blowing the whistle causes the powder to form small piles showing that standing waves are produced. The wave nodes are formed at the peaks of the heaps. If the whistle

is blown harder the number and position of the heaps will change.

Discuss that the quality of a sound depends upon 1) the number of the overtones produced by the sounding body and 2) the manner in which the sounding body is set in vibration.

Any career dealing with musical instruments and their upkeep would need a basic understanding of their methods of sound production and harmonics.

14 Acoustics

a. Examine a square of acoustical tile from your school. Name other ways sound waves are absorbed to keep noise levels down (curtains, draperies, carpets, clothing, upholstery on furniture).

b. Compare the noise levels produced in a gymnasium or swimming pool area with those in the classroom. What causes the difference?

c. Examine the school auditorium and discover ways sound is directed and controlled. The study of the sound properties of room and buildings has been very highly developed and comes under the title of architectural acoustics.

15 Architectural Acoustics

Discuss how the curvature of a ceiling can create a whispering gallery. This relates geometry to physics. Examples: The

Capitol in Washington, D. C. has a Hall of Statues with a dome-shaped roof. The Union Terminal in Cincinnati is another example.

16 Noise Pollution

Refer to Activity 3 in Unit III - Conservation - Ecology.

17 Visit a broadcasting studio to gather information concerning the acoustical treatment that has been applied in the studio. This visit is also a good opportunity to relate sound with many other careers in electronics and administration. Find out how various sound effects are produced for broadcast purposes.

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Feravolo, Rocco. Wonders of Sounds. New York: Dodd, 1962.

Schulz and Lagemann. Physics for the Space Age. New York: J. B. Lippincott Company, 1966.

Swezey, K. M. After-Dinner Science. New York: Whittlesey House, McGraw-Hill Book Co., Inc., 1948.

700 Science Experiments for Everyone. New York: Doubleday and Co., 1958.

Williams, Metcalfe, Trinklein, Lefler. Modern Physics. New York: Henry Holt and Co., 1968.

Magazine reference: "Fortune" - October, 1969, p 130 - "Its Time To Turn Down All That Noise".

Suggested Films

427	Sound Waves	27 min.
1425	Behind the Scenes at the Airport	10 min.
1695	What is Sound	11 min.
1697	Fundamentals of Acoustics	11 min.
1885	Getting a Job	16 min.

1911	Ear and Hearing	10 min.
2491	An Airplane Trip by Jet	11 min.
2664	Voice Beneath the Sea	25 min.
2674	Communications for Civil Defense	22 min.
2743	On the Air	22 min.

Films from: Shell Oil Co.
450 N. Meridian St.
Indianapolis, Indiana 46204

	Approaching the Speed of Sound - Color	27½ min.
	Beyond the Speed of Sound - Color	19 min.

Filmstrips

6205	Wonder of the Phonograph
6466	Light, Heat and Sound
6507	Skilled Occupations, Part II
6512	Occupations in Aircraft Operation

Resources in the Community

Cincinnati Bell Telephone Co.
Contact: Sue Lay
Telephone: 397-2669
Pamphlets, posters, and speakers available

Free or Inexpensive Teaching Aids

1. Encyclopedia Brittanica Educational Corp. Reference Division, 425 North Michigan Ave., Chicago, Ill. 60610. .25¢

   Sound - 8 page illustrated teaching guide. Concept chart in color; large clear diagrams and drawings, outline, suggested activities; and list of resource articles.

2. Telephone pamphlets available free from Bell Telephone Business offices. Titles include:

   - Mr. Bell Invents the Telephone. 83 pp
   - The Birth and Babyhood of the Telephone. 46 pp
   - The early Corporate Development of the Telephone. 31 pp
     The story of the Bell Telephone Company.
   - How the Telephone Works. 16 pp
   - The Magic of Your Telephone. 24 pp
   - The Telephone in America. 64 pp
     Pictures showing the evolution of the telephone.
   - The Telephone You Command. 24 pp

3. Communications Bulletins, Federal Communications Commission, Office of Reports and Information, Washington, D.C. 20554. Single copies free.

4. Field Enterprises Education Corp., Directory Educational Services, Merchandise Mart Plaza, Chicago, Illinois 60654.
   Reprints from The World Book Encyclopedia. Single copies free to teachers and librarians, 25¢ to others.

5. Free Loan Films Catalog.
   Association Films, Inc., 347 Madison Ave., New York, N.Y. 10017.
   58 pp. Free. Contains lists of films that are free except for return postage.

6. Using Your Tape Recorder.
   Allied Radio Corp., 100 N. Western Ave., Chicago, Illinois 60680.
   95 pp. 50¢. The ABC's of tape recording - how tape recorders work, recording techniques and applications. Well illustrated.

7. R.C.A. Victor Record Division, Education Department, 155 East 24th St., New York, N.Y. 10010.
   A picture-story of the manufacture of RCA Victor records.

Careers Related to Sound

Acoustical engineer: Applies laws of acoustice to all types of construction from musical instruments to large assembly halls. A college education in accoustical engineering is necessary.

Speech Pathologists and Audiologists: Speech pathologists and audiologists help people suffering from speech and hearing disorders by diagnosing their problems and by providing treatment. The duties performed by these men vary with their education, experience, and employment setting. A bachelor's degree is required for a beginning job as a speech pathologist or audiologist.

Additional information may be obtained by writing to: American Speech and Hearing Association, 1001 Connecticut Ave., N.W., Washington, D. C. 20036.

Sound Effects Technicians: This career deals with the operation of special equipment to simulate sounds such as gunfire, thunder or falling water, during rehearsals and broadcasts.

*Audio control technician: Operates controls that regulate sound pickup, transmission and switching.

*Video tape recording technician: Operates and maintains magnetic video tape recording equipment.

Telephone Operators: Central office operators work at telephone company switchboards and are usually contacted when callers need assistance. Long distance operators and information operators also provide callers with assistance.

PBX operators operate switchboards which serve business offices and other establishments which are connected with telephone company lines.

They make connections for interoffice or house calls, answer and relay to the proper parties the calls from the outside, assist other company employees in making outgoing calls and supply information to callers. Many act as receptionists.

A high school education is necessary for most positions.

Telephone and PBX Installers and Repairmen: The telephone installer installs and removes telephones in homes and places of business. The telephone repairman tests, diagnoses, locates, and repairs trouble on customers' telephones in order to restore service. The telephone installer-repairman combines the duties of the installer and repairman.

The PBX installer installs telephone switchboards and other specialized communication equipment on customers' premises.

Telephone companies prefer to hire inexperienced men and train them for telephone and PBX installation and repair jobs.

A person interested in these occupations must be a high school or vocational school graduate with mechanical ability and manual dexterity. Since there are probably no direct work experiences available to students, a field trip to a telephone company can give an overall view of the work done.

Radio and Television Announcers: Radio and television announcers present news, commercials, introduce programs, conduct interviews and many other tasks associated with this type of work.

Most large stations usually demand a college education. Poise and a pleasing voice and personality are of great importance to this profession. One way to enter this field is to apply for a job which is not that of announcer. After learning the operation of a station it may be possible to change jobs when a vacancy occurs on the broadcasting staff.

Sounder: Measures depth of water at designated points along navigable waterway using leadweighted line, marked to indicate depth. This is done in order to facilitate charting of waterways and determine need for dredging or other marine construction activity.

Sound Technician: Installs, maintains, and services sound and intercommunication systems and closed circuit television systems. He tests installation to verify proper functioning. Tests, trouble-shoots, and services equipment. May install high-fidelity components or systems for playing musical recordings in homes or business establishments.

Sound Proofer: Sprays asphalt compound over interior of car bodies prior to upholstering to reduce road noise and vibration.

Insulation Installer: Fastens sheets, bat, blanket and similar types of building insulation to walls, floors, ceilings and partitions to reduce passage of heat, cold or sound.

Insulation Hoseman: Blows insulation material into spaces within walls, floors and ceilings using a hose, attached to a blower, to insulate buildings.

* Anyone interested in becoming a broadcast technician should plan on getting a Radio-telephone First Class Operator License from the F.C.C. The license is required by Federal law.

UNIT X

LIGHT AND SEEING

ACTIVITIES

No. of Activity

1 Source of Light

Have the pupils report on sources of light including the sun, the torch, the candle, the kerosene lamp, the gaslamp, the gasoline lamp, the electric light, the fluorescent light, the mercury light and the neon light. Describe how each source produces light. Make a display of as many of these sources as are available.

2 Transparent, Translucent, and Opaque Materials

Darken the room and aim a beam of light from a focusing flashlight at a clear pane of glass. A distinct spot will be seen on the wall as the light passes directly through the transparent material. Now aim the beam at a pane of frosted glass or piece of wax paper. Light will pass through, but it will be dispersed by the translucent material and there will not be a distinct spot on the wall. Aim the beam of light at a square of cardboard. None of the light will pass through the opaque material. Place a lighted candle behind the clear pane of glass. The candle is seen clearly through the transparent material. Repeat, using frosted glass or wax paper, and the candle will not be seen clearly through the translucent material. The candle will not be seen through opaque cardboard.

3 The Speed of Light

Report on how the speed of light was determined. Calculate the time it takes for the sun's rays to reach the earth, 93 million miles away. Some pupils may be interested in calculating the distance travelled in one light year. This distance can be found by multiplying 186,000 by 60 seconds, then by 60 minutes, then by 24 hours and then by 365-1/3 days. Multiplying this answer by 3-1/4 will give the distance travelled in a par-sec.

4 Experimenting With Light

Dissolve a few crystals of silver nitrate in distilled water. Add a little table salt and shake the mixture. A curd-like material will form in the solution. This material, silver chloride, is used in making photoprint paper. Separate the curd into two parts. Keep one in the dark. Expose the other to light. Compare the two after a time. Explain what happens. Discuss how this activity relates to the photographer's work.

5 Ultraviolet Rays

Report on ultraviolet rays: where they are found, the burns they can produce, their effect on phosphors to produce fluorescence and their use in science, medicine, and industry.

6 X-Rays

Borrow some x-ray photographs of bones and other parts of the body from your local doctor and let pupils examine them. Report on the use of x-rays in medicine and in industry.

7 Demonstration of the Light Meter

When planning lighting installations or when taking photographs, it is necessary to know the amount of illumination available. The instrument used is called a light meter. The light meter contains a light sensitive cell which transforms the illumination falling on it into an electric current. The amount of illumination and the electric current produced are proportional within the range of the instrument. A light meter can be calibrated directly in lumens per square foot or in foot-candles. Lighting engineers and photographers would use this instrument in their careers.

Use a light meter to determine the intensity of illumination in various areas of the school building. Learn how to use a light meter to determine exposures in photography.

8 The Refraction of Light

With the use of an incandescent lamp illuminator as a light source and an optical disk, demonstrate how light is bent as it passes obliquely from one medium into another medium of different optical density. The index of refraction of a pure transparent substance is a constant quantity which is a definite physical property of the substance. Consequently, substances can be identified by measuring their index of refraction. For example, butter fat and margarine have different indices of refraction. One of the first tests made in a food-testing laboratory to determine whether butter has been adulterated

with margarine is the measurement of the index of refraction. Careers associated with the Pure Food and Drug Administration could be discussed here.

With the use of the optical disk and illuminator, demonstrate how convex and concave lenses refract light. By use of this demonstration show pupils the practicality of lenses in eye glasses. At this point careers of ophthalmologist, optician, and optometrist could be discussed.

9 <u>After image or duration of vision</u>

Have pupils look at a bright electric light bulb for a few seconds. Then ask them to close their eyes and ask what they observe. The image of the light will persist on the retina for a short period of time. Because of this phenomenon we are capable of observing motion pictures. The eye retains the image of one picture until the next picture appears, thus we get the illusion of continuous motion. The motion picture industry could be discussed with the many careers associated with it.

10 <u>Demonstrate the mixing of colors</u>

With a standard slide projector and a color mixing slide show the effects of mixing colors and pigments. The overlapping sectors show the colors which would result from mixing colored lights on a white screen. Also with the use of a color disk demonstrate that the primary colors in the proper ratio will produce white when rotated rapidly.

11 Polarization of Light

With a polarization kit demonstrate the polarization of light. A chemist uses polarized light to analyze many chemicals and in identifying many crystals. Manufacturers of automobiles and machine parts use polarized light to examine materials to learn how they behave under applied stress. Polarized light transmitted by certain types of sun glasses eliminates the annoying glare when bright sunlight is reflected from a surface.

12 The Spectroscope

Demonstrate the spectroscope. Use the spectroscope in observing spectra of certain elements. Discuss how chemists use the spectroscope to identify atoms and molecules of a given sample of material. Discuss how astronomers use the spectroscope to reveal many characteristics of the distant stars.

Selected References

Adler, Irving. The Secret of Light. New York: International Publishing Co., 1952.

Paschel, Herbert P. The First Book of Color. New York: Watts, 1959.

Perry, John. Our Wonderful Eyes. New York: McGraw, 1955.

White, Harvey. Physics, An Exact Science. Van Nostrand, 1959.

Williams, Metcalfe, Trenklein, and Lefler. Modern Physics. New York: Henry Holt and Company, 1968.

Suggested Films

15	College Ahead	30 min.
2909	Highlights and Shadows	55 min.
9	How to Bend Light	11 min.

1802	How Television Works	10 min.
2049	Learning About Light	8 min.
1678	Lenses	10 min.
65	Light and Color	13⅓ min.
2129	Nature of Color	13 min.
2407	Science of Light	8 min.
1333	X-Ray Inspection Method	20 min.

Modern Talking Pictures Service, Inc.
9 Garfield Place
Cincinnati, Ohio
Phone: 421-2516

a) Optometry - Film #2373 - A Career with Vision

Color - 15 min.

b) Sight - Film #2235 - The Wondrous World of Sight

Color - 28 min.

Filmstrips

6635	Light
6711	X-Ray Inspection Method

Models

8002	Eyeball
8005	Eye in Bony Orbit

Free or Inexpensive Teaching Aids

1. Telescopes You Can Build - Book No. 9068. 35 pp - 75¢
   Edmund Scientific Co., 801 EDSCORP Building, Barrington, N.J. 08007
   Send for catalog.

2. Pamphlets on eye care - National Society for the Prevention of Blindness, Inc., 79 Madison Ave., New York. N.Y. 10016.
   Single copies free. Complete catalog of publications sent on request.

3. Optometry - American Optometric Association, Inc., 7000 Chippewa St., St. Louis, Missouri 63119
Send for list of materials describing optometric careers.

4. Health Pamphlets
William Frederick Press, 55 East 86th St., New York, N.Y. 10028
15¢ each

5. Your Eyes and How They Function
Bausch & Lomb, Inc., Rochester, New York 14602
23 pp. Single copy free to teachers.

6. Light
Encyclopedia Brittanica Educational Corp., Reference Division
425 North Michigan Ave., Chicago, Illinois 60610
25¢ each

Speakers:

1. Photography
Professional Photographers of Greater Cincinnati
Dr. Daniel W. Crey, President - c/o 2613 Alexandria Pike,
Ft. Thomas, Kentucky
441-3554

2. Laser
Bell Telephone Co.
Contact Sue Lay - 397-2669

Careers Related to Light and Seeing

Ophthalmologist: Ophthalmologists, also known as oculists, are physicians who specialize in the treatment of eye diseases and disorders. They examine eyes to determine remedies needed to conserve or improve vision. They diagnose eye diseases, infections, injuries, and other disorders, and prescribe medicines, therapy, corrective lenses or surgery. Some ophthalmologists specialize in surgery. Others limit their practice to treatment of children and are known as Pediatric Ophthalmologists. A license to practice general medicine is required before a physician can specialize. To qualify for this license, a candidate must graduate from an approved medical school, pass a licensing examination, and serve a one-year hospital internsship.

Optometrist: An optometrist specializes in the examination of the eyes for the conservation and improvement of vision. He makes a complete vision analysis, administering a series of tests to determine the efficiency of the eyes for both distance and near point vision. If deficiencies are found, he prescribes and provides any eyeglass lenses, contact lenses, visual exercises, or other specialized services necessary to achieve accurate, comfortable and efficient sight.

All states require optometrists to be licensed; no one is eligible to take licensing examination unless he or she is a graduate of an approved optometry college.

Opticians: Opticians receive a prescription for lenses from an ophthalmologist, from an optometrist, or from the patient himself who was given the prescription by one of the above specialists. The optician is not trained to examine or treat the eyes but is concerned only with fitting glasses

to the patient and/or grinding the lenses.

Generally, the required minimum formal education background is high school graduation. Specialized training can be secured in several ways - as a helper or informal apprentice, as a formal apprentice, or by attending a specialized school.

Dispensing Opticians: The dispensing optician makes certain that eye glasses follow the prescription and fit the customer properly. In some states, they may also fit contact lenses. Most dispensing opticians learn their skills through informal on-the-job training. Many are employed by retail optical shops or optical departments of department stores.

Optical Mechanics: There are two principal types of optical mechanics. The surfacer grinds and polishes the surface of the lenses and makes sure that the ground lenses conform to the prescription requirements. The benchman marks and cuts the ground lenses to fit the frame, bevels or smooths the edges, and assembles the lenses and frame parts into the finished eyeglasses. Most optical mechanics learn their skills through on-the-job training.

Photoengravers: This profession involves the making of metal plates which cannot be set up in type. On these plates, the printing surfaces stand out in relief over the non-printing surfaces. The process involves the transferring of negative film onto metal plates. The plate is then placed in acid bath which eats away areas not to be printed.

A high school diploma is necessary and courses in chemistry and physics should be taken. It takes several years or more to become a skilled photoengraver.

Photoengravers are among the highest paid printing craftsmen.

Photographers: Photography can be both an artistic and a technical occupation. The photographer must have the ability to use different kinds of lighting equipment, different kinds of cameras, and various special effects with filters. At the same time, the photographer must have the ability to determine what is correct composition and what is not.

A college education is not required to become a photographer, however specialization may require a higher education.

Color-Printer Operator: The color-printer operator controls semiautomatic equipment to produce color prints from negatives. He examines the color negative to determine equipment control settings for production of prints meeting acceptable color-fidelity standards. He then sets the controls in accordance with examination, loads the negative into the machine, and starts the machine to produce the specific number of prints needed.

A high school education is preferred by most companies. Generally, an on-the-job program is available for training.

Medical X-Ray Technicians: X-ray technicians specialize in both exact scientific procedure and care of the patient. Most technicians do diagnostic work, using X-ray equipment to take pictures of internal parts of the body. To prepare patients for X-ray, technicians position them between the X-ray tube and the film and cover the body areas not to be exposed to the rays with a protective lead plate.

The technicians also keep the equipment in good working order by cleaning it and making minor repairs.

Training programs in X-ray technology are conducted by hospitals or by medical schools. The program usually takes two years to complete.

All of the approved schools require that applicants be high school graduates and a few require one or two years of college.

High school courses in mathematics, physics, chemistry, biology and typing are considered desirable.

Training also may be obtained while serving in one of the military services or through experience gained on the job under the supervision of a radiologist.

There is a continuing need for technicians to staff rapidly growing hospital and medical programs.

Industrial X-Ray Technologist: The X-ray technologist controls radiography equipment to take radiographs of metal castings, weldments, metal samples, pipes, machinery and structural members to detect flaws, cracks, porosity and the presence of foreign objects. Not only does he make all the proper adjustments to take the radiograph, but he must also develop the film himself.

This occupation requires not only a high school diploma, but also special training in X-ray technology.

Light Technician: Positions and operates lighting equipment for television broadcasts. Studies the script to determine lighting effects required.

UNIT XI

ELECTRICITY AND ITS USES

ACTIVITIES

No. of Activity

1 Making a Temporary Magnet With Electricity

Obtain some insulated copper bell wire (No. 18) from the warehouse or store. Wind the wire in a coil around a large iron nail or spike about 15 or 20 times. Remove the insulation from both ends of the wire, connect one end to a terminal of a dry cell, and touch the other end to the second terminal for a few seconds. When the ends of the wire are connected to the terminals the nail will pick up tacks and other objects made of iron or steel. This device is called an electromagnet. Relate how this knowledge is essential to certain careers in electricity.

2 Electrical Units of Measure

Have pupils examine a variety of electrical appliances in the home (such as toasters, mixers, blenders, light bulbs, heaters, etc.) and list the number of watts printed on each appliance. Have pupils calculate the current each appliance will draw, assuming that 120 volts is being used. Then let them find the resistance of each appliance. Have pupils observe a kilowatt hour meter when electricity is passing through it. Study the unit on each dial and develop an understanding of the watt, kilowatt, and kilowatt-hour. Discuss how this knowledge is needed by electrical appliance servicemen, automatic washer repairmen, etc.

3 Heat and Light from Electricity

Push the ends of two pieces of bell wire through a flat cork that fits a small bottle. Now untwist a piece of ordinary iron picture wire and cut off a short piece of a single strand. Wind the ends of this short piece of picture wire around the projecting ends of the copper wires and insert the cork into a bottle. The result is a crude model of an electric lamp. Connect the electric lamp model into a circuit of six to twelve volts and a switch. Close the switch until the fine wire (filament) begins to glow, then open the switch again. With care the lamp can be lighted several times before the filament is consumed.

4 Useful light from gas tubes

Using spectra tubes, excite the electrons of neon, argon, mercury vapor, etc. to demonstrate the various colors of light produced. Relate this to the occupations in the field of sign advertising.

5 Direct pupils in making and presenting reports in class on the following topics:

(1) Photoelectric application in industry

(2) The use of infrared lamps in industrial heating processes

(3) Electric arc furnace and its role in steel making

6 Demonstrate the production of electricity by chemical action

a. Cut two slits in the skin of a lemon. Push a strip of copper into one and a strip of zinc into the other. Connect a wire from the copper plate to the positive (+) post of a low

voltage voltmeter or galvanometer and another wire from the zinc plate to the negative (-) post. Read the voltmeter or galvanometer.

b. Connect a carbon rod and a piece of zinc to a voltmeter with the carbon rod connection to the positive (+) post, and place them both in a dilute solution of hydrochloric acid. Read the voltmeter. Repeat part B using the carbon rod, a piece of zinc, and a concentrated solution of ammonium chloride (NH_4Cl). Compare the direction of the flow of electricity between the two.

7 Demonstrate how a generator produces an electric current

Take some fine insulated wire and wind about fifty to one hundred turns around a hollow mailing tube. Connect each end of the wire to the two posts of a sensitive galvanometer. Then push one end of a strong bar magnet through the center of the coil of wire. Observe the galvanometer. Have another person hold the coil of wire. Push the magnet all the way through and observe the galvanometer. What would be the result if the coil of wire were to move instead of the magnet. Also demonstrate a model magneto electric generator and discuss how it functions.

8 What do magnetic lines of force look like?

Put two bar magnets on a table with the north pole of one about an inch from the south pole of the other. Put a piece of glass or cardboard about ten inches square over the magnets. Sprinkle a thin layer of iron filings on the glass or cardboard.

Tap the glass or cardboard very gently. Do the iron filings arrange themselves in a pattern? Repeat the same experiment but put the north poles of the magnets about an inch apart. Do the iron filings arrange themselves differently?

9 Magnetic lines circle a conductor

Pass a vertical wire through a piece of cardboard about six inches square. At each of the four corners of the cardboard place a small magnetic compass. Pass a weak current through the wire. The compass needles are deflected until they become nearly tangent to the magnetic lines about the conductor. When the current electrons flow upward, the magnetic lines circle the conductor in a clockwise direction. When the current flows downward, the magnetic lines circle the wire counter-clockwise. The motor and generator work because of this principle.

10 Electromagnets and the telephone

Discuss the importance of the electromagnet in the telephone. Discuss the many careers offered by the telephone company. Ask the telephone company for the use of their many excellent films, maybe arrange a visit to the telephone company or take advantage of the telephone company speakers' bureau.

11 A fuse is a safety device for an electric circuit

Refer to pages 116 and 117 of Curriculum Bulletin Number 21, Eighth grade Science and Health.

Selected References

Field, S. and A. D. Weill. Electroplating. New York: Pitman Publishing Corp., 1938

700 Science Experiments for Everyone. New York: Doubleday and Company, Inc., 1958.

White, Harvey E. Physics, An Exact Science. Van Nostrand, 1959.

Williams, Metcalfe, Trinklein and Lefler. Modern Physics. New York: Henry Holt & Company, 1968

Suggested Films

222	Electricity and How it is Made
282	Exploring Electromagnet Energy
1333	X-Ray Inspection Method
440	Static Electricity
221	Current Electricity
439	Production of Electricity
228	Measurement of Electricity
1683	Measurement of Electricity
1324	Home Electrical Appliances
1802	How Television Works
2667	Engineering Career for Tomorrow
2743	On the Air

Filmstrips

6204	Wonder of the Telephone
6202	Wonder of Electricity

Free or Inexpensive Information

1. Women in Broadcasting - American Women in Radio and Television, Inc., 77 East 55th St., New York, N.Y. 10022
$1.00 Shows the broad spectrum of jobs available and the characteristics needed to succeed.

2. Television Information - Television Information Office, Department of FIL, 666 5th Ave., New York, N.Y. 10019.
Single copies free.

3. Radio and Television - Allied Radio Corp., 100 North Western Ave., Chicago, Ill. 60680

4. Communications Bulletins - Federal Communications Commission, Office of Reports and Information, Washington, D.C. 20554.
Single copies free.

5. Electricity - General Motors Corp., Public Relations Staff, General Motors Building, Detroit, Michigan 48202.
Free to educators when requested on school stationery.

6. Nuclear Energy - U. S. Atomic Energy Commission, P.O. Box 62, Oak Ridge, Tenn. 37830
Single copies free.

7. Bell Telephone Booklets and Teacher's Manual.
Available from most local Bell Telephone business offices. Free.
Presents and explains physical science laws, fundamentals, and concepts related to communications.

8. Corrosion - American Zinc Institute
Field Office, 324 Ferry St., Lafayette, Indiana 47901
Single copies free to teachers and librarians.
Titles include:- Galvanic Action Kit
- Principle of Corrosion for General Science
Shows how the principles of electricity relate to corrosion

9. Film catalog on Electronics
Hughes Aircraft Co., K. G. Brown, Public Relations and Advertising.
Building 130, Mail Station 43, P.O. Box 90515, Los Angeles, Californis 90009
Send for free catalog describing motion pictures available on free loan basis.

10. Programs of Cincinnati Gas & Electric Company, Community Relations, Fourth and Main, Cincinnati, Ohio 45202
Telephone: 632-2768

Careers Related to Electricity

Electroplaters: The electroplater coats an object with metal by placing it in a metallic-salt solution which is decomposed by electrolysis. Those interested in this occupation should have some knowledge of and interest in electricity, chemistry, and metallurgy. Most electroplaters learn the trade as apprentices. They may enter the occupation as helpers and learn the details of the trade on the job. This usually takes 3 to 4 years.

Construction Electrician: Duties of this career involve assembling, installing, and repairing circuits in all types of buildings. Those interested in this career should be agile, have better-than-average finger and hand dexterity and be interested in working with their hands. On-the-job training is the only accepted method of securing knowledge to qualify as a Journeyman Electrician. The apprenticeship is a four year program offering experience on the job and classroom instruction. To qualify for an apprenticeship, one must be 18 to 24 years of age and be a high school graduate. Electricians earn among the highest hourly wages of all skilled building trades workers.

Arc Welding Machine Operator: The Arc Welding Machine Operator uses automatic welding equipment to join metals by applying intense heat. Persons interested in this career should possess good eye, hand, and foot coordination and mechanical aptitude. The career may be learned in a matter of weeks. There are many related jobs such as auto-body repairman, structural steel welder, or ship building worker.

Electrical Repairman: An electrical repairman is a skilled electrician whose duty is to keep electric wiring and equipment such as generators, motors, etc. in efficient operation. He may also be called a maintenance electrician or an electric motor repairman. Those interested in the trade should have a liking for electrical work and be mechanically inclined. They should also have the ability to learn new skills while on the job.

Electrical Appliance Serviceman: The electrical appliance serviceman is skilled in the knowledge and mechanics of household appliances to the extent that he is able to install, maintain, and repair them. In this occupation, most skill and knowledge is generally acquired on the job A high school education is generally necessary. Most large manufacturers of appliances maintain schools which trainees may attend upon recommendation. While in high school, aspirants should include algebra, physics, geometry, mechanical drawing and shop courses in their studies.

Meter Reader: is employed by a utility company and reads the recording dials of electric, gas, water, or steam consumption meters. He must also inspect meters and their connections for defects, damages, and unauthorized tamperings. Although there is no minimum educational requirement for applying, applicants should be able to speak, read, write and follow simple written and oral directions. The beginner learns his job by spending a few days making the rounds with an experienced meter reader.

Electrical Engineering Technician: This career involves work with generation of electrical power and its transmission, distribution and use. The electrical engineering technician assists engineers in performing this

work as well as with the manufacture of electrical machinery. A high school diploma is necessary for entrance into most schools offering technician training. Schools for technicians are of three types: technical schools, junior colleges, and special two or three year programs in senior colleges. Anyone interested in this line of work should be highly accurate in his work and have good mechanical and electrical interest and aptitude. He must also be proficient enough as a writer to prepare technical reports and have an aptitude for sketching and drafting.

Linemen: construct and maintain the power lines that carry electricity from generating plants to consumers. The erection of electrical towers and stringing of wires is often contracted out to firms specializing in this type of work.

Trouble men: These men are experienced linemen who are assigned to special emergency crews. They locate the source of trouble and make the necessary repairs to restore service. These workers must have a thorough knowledge of transmission and distribution networks and all the circuits and switching points so they can disconnect live circuits before making repairs.

Cable splicers: Are responsible for installation and maintenance of underground lines. The cables are joined at connecting points in the transmission and distribution systems. These men splice wires at junctions of main cables and enclose the joints with a lead joint.

Telegraphers, Telephoners, and Towermen: Railroad telegraphers, telephoners, and towermen regulate the movement of trains by passing train orders and movement instructions received from dispatchers to train crews.

Towermen carry out the orders by setting signals to route trains in keeping with time schedules or special orders.

Most railroad companies prefer applicants between the ages of 21 and 30 who are high school graduates. Requirements for good eyesight and hearing are strict. The majority of these workers receive their training on the job under the supervision of experienced men. However, trainees must usually pass examinations given by the company before they are eligible for temporary or regular job assignments.

Electrocardiograph Technician: Records electromotive variations in the action of the heart muscle, by using an electrocardiograph machine, to provide data for diagnosis of heart ailments.

The technician attaches electrodes to specific areas of the body in order to make the recordings.

Lightning Rod Erector: Installs lightning rods on roofs of houses and barns. Nails rod onto the chimney or other part of roof using handtools.

UNIT XII

WATER

Water covers three-fourths of the earth's surface. The sea presents one of the greatest frontiers for exploration because less is known about the sea than about the planets. Water dissolves more things than any other natural solvent. Running water is the main force for wearing down the earth's surface. It is essential to the chemistry of life. Man is rapidly destroying our fresh water supply and all the life it supports. Slowly he is also destroying the sea. To understand water, the most common substance on earth, is survival. For man to not understand it and through ignorance destroy it, means death for the whole earth.

ACTIVITIES

No. of Activity

1 Liquids Assume Shape of Container

Using containers of several shapes and sizes, pour a quantity of water from one to the other. Record your observations. This illustrates that water has no shape but a definite size, thus making it a liquid.

2 Some characteristics of pure water

Boil some tap water for several minutes and then allow it to cool to room temperature. Look at the water for clarity, and color. Smell and taste the water. Record the observations. The boiling drives out the chlorine that was added in the purification process thus giving us a purer water. The pure water is a colorless, odorless, tasteless clear liquid.

3 Water as a solvent

Fill five test tubes with water. Into one add a half teaspoon of sugar, into another one-half teaspoon of flour and into the third one-half teaspoon of alcohol. Into the one with alcohol add one-half teaspoon of a thin oil. Mark all tubes for identification. Shake all tubes well and let them settle for a couple of minutes. Record observations. This experience shows that even though water does dissolve more things than any other natural solvent it does not dissolve all things.

4 Occurrence of Water

Have a pupil report on the places where water is found and the approximate quantities in some of these. Such a report will include such things as:

In general, plant bodies are composed of 90% or more water.

Animal bodies contain, in general, over 60% water.

The world oceans contain over 97% of the earth's water.

2% of the earth's water is locked up as ice in glaciers and ice caps.

A little less than 1% of the earth's water is in the rivers, lakes, ponds, etc.

This report will show that water is the most abundant compound on earth and that it is distributed everywhere.

5 Buoyancy of ice

Measure an ice cube. Put the cube in water and measure the amount of the cube that is above the water. Record your observations. Explain buoyancy (Archimedes' principle).

Have pupils explain the importance of ice being lighter than water. (All oceans, etc. would be solid ice if ice were heavier than water.)

6 Temperature for change in phases of water

Place crushed ice in a beaker one-half full of cold water. Place a thermometer in the ice water and stir. When the temperature of the water stops changing, record the temperature. This point is the temperature at which water freezes or melts. Heat the water to boiling. When the temperature stops changing, record it. This point is the temperature at which water changes to a gas or the gas changes to a liquid.

7 Buoyancy - different liquids

Float a cube of wood in a beaker or finger bowl. Mark the water line of the block. Stir three tablespoonfuls of ice cream salt into the water. Once more mark the water line of the block. Record the observations. Consider your observations in the problem a sea captain might have in loading a barge to be moved from the sea into fresh water such as from the Atlantic Ocean up the St. Lawrence Seaway to the Great Lakes.

8 Evaporation

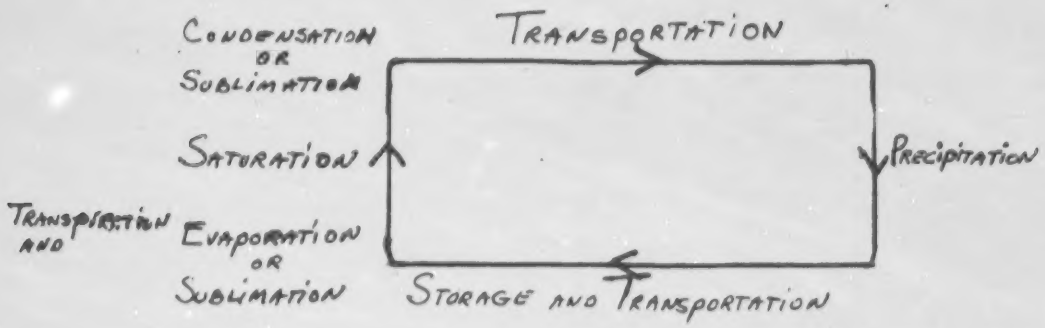
Place a few small drops of water on a non-absorbing surface such as a piece of glass. Time how long it takes it to evaporate. Record the observation. Discuss what evaporation is in terms of molecular action.

9 Condensation

Refer to Unit XIV on "Air and Weather" - Activity 3d.

10 Water cycle

Make a diagram on the board of the water cycle. Discuss all terms used.



11 Water locations

With the aid of diagrams made on the board, discuss surface water, ground water and the water table.

12 Uses of water in nature

List on the board and discuss briefly what water does in nature. Such a list follows:

a. Transports heat in attempting to bring the earth into a temperature balance.

b. Transports soil and minerals causing both erosion and deposits.

c. Transports food, oxygen and/or carbon dioxide and minerals to all water life. Also transports wastes away from such life.

d. As the vehicle of blood and sap, it carries the materials for all forms of life not living in water directly.

e. Furnishes the medium in which most of the chemical reactions of nature take place.

f. In the form of clouds it acts as a filter for much of the sun's radiation.

g. By blocking long heat waves it helps to prevent heat loss from the earth's surface.

h. By changing state it both cools and heats.

13 Convection currents

Into a large beaker place half a handfull of confetti made from a paper towel. (This can be made easily and quickly with a paper punch.) Fill the beaker with water. Place the beaker on a tripod and heat one side of the bottom of the beaker until the water is boiling. Then lower the flame until the water is just under the boiling point. Record your observation. Shift the flame to the other side of the beaker and record your observation. Explain your observations. This experiment demonstrates the main cause of convection currents in the oceans.

14. Erosion experiments

See Unit IV on Geology - Activities 5, 7, 9, 11, 12, 13, 17, 20.

15 Microcosm

To show how water transports food, oxygen, etc. for organisms living in it, set up a microcosm at the beginning of the school year and observe the life activities within the sealed unit during the entire year.

16 Observation of Blood under microscope

Wrap a small goldfish in a piece of wet cloth with its tail free. Place the fish on the stage of a microscope and focus on the blood vessels in the tail. This blood is essentially water and is carrying on all necessary transport for the life of the cells in the body of the fish.

17 Temperature changes: Ice-water mixture

Half fill a 250 ml beaker with warm tap water. Measure the temperature of the water and record same. Place several ice cubes in the water and record your observations of the change of temperature and size of the ice cubes. Explain. The ice melts by taking in heat from the water.

18 Mans' use of water

Make a list on the board of all the things man does with water. Such a list follows:

Man uses water to:

a. Drink - for life
b. Cook with - to make foods safer and tastier.
c. Growing food - natural watering and irrigation
d. Cleaning -
e. Bathing - to clean our bodies.
f. Transport of sewage
g. Fire fighting
h. Sport
i. Power - hydroelectric - steam
j. Industry -

k. Air conditioning - heat exchange and evaporation

l. Cooling - atomic power plant cooling towers, etc.

19 Value of cooking food to make it safe

Collect some water with many bacteria in it (from an aquarium, pond, hay infusion, etc.). Set part of the sample aside and boil the rest. Using a microscope examine the boiled and unboiled portions of the sample. Record your observations. This shows how cooking can help make food safer to eat.

20 Water essential for plant growth

Start two coleus plants growing, each in a separate pot. After they are growing well continue giving one plant the required water but give the other plant none. Record your observations daily for several weeks or until the unwatered plant dies. This experiment shows the importance of water to growing things.

21 Model water wheels

As a project for one or more pupils have them build working models of several kinds of water wheels and give reports on same.

22 Steam engine

If a working model steam engine is available, operate it and have some pupils report on the history of the steam engine and its role in the economic development of the country. Also, include in the report the possible future of the steam engine in the form of steam turbine engines and nuclear powered engines.

23 Water in Industry

Have a pupil report on the use of water in industry such as in the manufacture of one ton of steel or paper, etc. Have the pupil include the basic ways this water is used.

24 Heating systems

With the aid of diagrams and pictures discuss the way in which each of the following work:

a. Hot water heating system.

b. Low pressure steam heating system.

c. High pressure steam heating system.

Discuss the differences in each including the operation, laws and jobs involved with each.

Discuss the work of steam fitters, pipe fitters, plumbers, heating engineers, stationary engineers, etc.

25 Air towers in air conditioning

Diagram and discuss evaporation towers in large scale air conditioning systems.

26 Lakes

Find out what you can about the lake or lakes located in or near the area where you live. Learn how the basin was formed, and contrast this method of formation with the other ways that lake basins are formed. Discuss the different ways that lakes can be destroyed, and suggest some measures that could be taken to prevent this from happening.

27 Purify Water by Filtering

To a large plastic or glass funnel add a layer of small pebbles, then a layer of gravel or coarse sand, and finally a layer of fine sand. First pour some clean water through the funnel to allow the layers to settle and pack together. Then place the funnel in a narrow-mouthed glass jar and pour some muddy water into the funnel. The layers will filter the mud and the clear water will pass into the jar.

28 Make and Soften Permanent Hard Water

To a test tube half full of water add a small amount of epsom salt (magnesium sulfate) and shake the test tube until the salt dissolves. Pour the same number of drops of tincture of green soap into the test tube containing the freshly prepared permanent hard water and into a test tube containing an equal amount of distilled water or rainwater. Shake both test tubes vigorously and note the difference in amount of suds produced. Soften the permanent hard water by adding some washing soda, borax, or ammonia. Now add the same number of drops of soap solution as you did to the other two test tubes and note the increased amount of suds formed.

29 The Action of Detergents

Obtain some high-sudsing detergent (non-soap type). Prepare samples of temporary and permanent hard water. Obtain three test tubes. Pour some temporary hard water into one test tube, an equal amount of permanent hard water into the second test tube, and equal amount of distilled water or rainwater into

the third test tube. Now add the same amount of detergent to each test tube and shake the test tubes vigorously. Note that all three test tubes have lots of suds, showing that the sudsing (and cleaning) action of this type of detergent is not affected by water hardness.

30 Commercial Water Softeners

Have pupils report on the use and treatment of such chemicals as Zeolite and resins for softening water in homes and factories.

31 Salt Water is more Buoyant than Fresh Water

Obtain two large, wide-mouthed jars and fill them about three-quarters full of water. Add salt to the water in one jar, stirring vigorously, until no more salt will dissolve. Now place an egg first in the fresh water and then in the salt water. The egg will float in the heavier, more buoyant salt water.

32 Test foods for the presence of water

Place a few small pieces of bread in a dry test tube and heat the tube gently over the flame of a Bunsen burner or alcohol lamp. Tiny droplets of water will appear on the upper parts of the test tube. The water was driven out of the heated bread in the form of steam, and then it condensed on the cool upper part of the test tube. Repeat the test, using a variety of food.

33 Water purification--for campers

Have a Boy Scout tell and show the class how to purify water on a small scale such as when camping or on a hike.

34 Water purification--settling

Fill a large bottle or beaker with muddy water. Allow the water to stand undisturbed for 24 hours. Observe how the water has cleared.

35 Water purification--city

Diagram and discuss large scale methods of purifying water for public consumption. Stress the method used by your community.

Suggested Field Trips

1. Millcreek Flood Control Plant
2. Cincinnati Water Works
3. Local dams and floodwalls
4. See Field Trips in Geology Unit on erosion
5. Sewage disposal plant
6. Erosion field trips

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Suggested Films

277	Waves on Water
1049	The River
1080	Mysteries of Water
1113	The Work of Rivers
1114	Ground Water
1145	The Work of Running Water
1344	Hydraulics
1411	What Makes Rain
1597	What Makes Things Float
1618	Derivation of Pascal's Law - Part I
1619	Derivation of Pascal's Law - Part II
1620	Application of Pascal's Law Part I
1641	Water Cycle
1696	Ohio River - Upper Valley
1839	Nature's Plan

1904 Brazilian Rain Forest

2080 A Visit to the Waterworks

2183 Water Wisdom

2241 Science of the Sea

2303 Boats: Buoyancy, Stability, Propulsion

2342 The Mathematician and the River

2537 Man in the Sea: The New Frontier

2586 The Restless Sea

Filmstrips

6340 Plumbing Repairs

6438 Exploring Water Sources

6439 Purifying Drinking Water

6786 Liquid Pressure

6787 Transmitting Pressure Through Liquids

6788 Buoyancy and Archimedes' Principle

6789 Density and Specific Gravity - Flotation

6790 Specific Gravity of Solids and Liquids

6795 Measuring Fluid Pressure

7677 A Career in Oceanography

Sources of Free and Inexpensive Material

See Unit IV - Geology; Unit XIII - Air and Weather

Careers Related to Water

Hydrologist: Studies distribution, disposition and development of waters of land areas, including form and intensity of precipitation, and modes of return to ocean and atmosphere. Maps and charts water flow and disposition of sediment. Measures changes in water volume due to evaporation and melting of snow. Studies storm occurrences and nature and movement of glaciers and determines rate of ground absorption and ultimate disposition of water. Evaluates data obtained in reference to such problems as flood and drought forecasting, soil and water conservation programs and planning water supply, water power, flood control, drainage, irrigation, crop production and inland navigation projects.

Sanitary Engineer: Designs and oversees construction and operation of hygienic projects such as waterworks, sewage, garbage and trash disposal plants, drainage systems and insect and rodent control projects: Plans development of watershed and oversees building of aqueducts, filtration plants and storage and distribution systems for water supply. Oversees swamp drainage, insect spraying and design of insect-proof buildings. Plans and directs workers in building and operation of sewage-disposal plant. Designs and controls operation of incinerators, sanitary fills and garbage-reduction plants to dispose of garbage and other refuse. Advises industrial plants in disposal of obnoxious gases, oils, greases, and other chemicals. Inspects and regulates sanitary condition of public places such as markets, parks and camps.

Industrial Waste Technician: Inspects industrial and commercial waste disposal facilities and investigates source of pollutants in conformance with ordinance and permit requirements, visits establishments to determine

if they have industrial waste permits, enforces provisions of permits and issues citations to violators of sanitation code. Inspects equipment used in treatment, disposal, and control of industrial wastes such as floor drains, settling and neutralizing tanks, clarifiers and sand traps, to insure that waste discharged into sewers, storm drains, etc. will not cause deterioration of sewerage facilities or pollution of water. This is done by checking sewer samples for water acidity, alkalinity, chlorine and hydrogen sulfate. Inspects sewers and storm drains to determine presence of explosive gas, using gas-detection equipment. Compiles written reports of investigations and findings and recommends actions needed. May operate chlorinating equipment in treatment of sewage.

Plumbers and Pipefitters: Install, change and repair pipe systems carrying steam heat, air, water, etc. to all types of structures.

Hydroelectric plant workers: watch, check, control and keep records of the operation of various kinds of equipment.

Hydrographic surveyor: makes surveys of harbors, rivers and other bodies of water. Person responsible for determining the depth of the water.

Many careers associated with the unit on Water can be found in other units:

Architects

Meteorologists

Fisherman

Farmers

Geologists

Civil and Agricultural Engineers

UNIT XIII

AIR AND WEATHER

A study of air, weather and climate is important because all of man's activities are influenced by them. Since weather is "the immediate conditions of the atmosphere" and climate "the average weather," a thorough knowledge of the atmosphere and the forces acting within it is needed to understand, predict and ultimately control both weather and climate for the benefit of all mankind.

ACTIVITIES

No. of Activity

1 Nature of the Atmosphere

Have the pupils make individual lists of all they know about the atmosphere. Then list on the board or overhead projector all the ideas that the class has about the atmosphere. (Be sure to point out any false ideas they may have. This can lead to a discussion on superstition.)

Guide the pupils in rearranging the ideas into (a) physical properties and (b) chemical composition and properties.

Next guide the pupils in grouping these under main catagories such as "All the things that make up pure air are gases". From this develop a definition of the air as a "colorless, oderless, tasteless mixture of gases".

2 Chemicals in the Atmosphere

Make a list of the chemical composition of the atmosphere. This could be done by a pupil who was assigned this as a library research project.

Such a list follows:

a. Nitrogen 78.00%

b. Oxygen 21.00%

c. Argon 0.90%

d. Carbon dioxide .03%

e. Hydrogen, helium, ozone, neon, xenon, krypton in very small quantities

f. Water vapor in varying amounts

g. Solid particles

3 Experiments Showing Properties of Air

Have individual pupils or small groups of pupils perform the following experiments to show the properties and composition of air: (These may also be done by the teachers as demonstrations.)

a. In a battery jar or small aquarium filled about 6 inches deep with water (make sure there is space for the water to rise several inches without overflowing) float a small cork. Push an inverted 250 ml. beaker into the water over the cork. Record observations and explain. This demonstrates that air occupies space.

b. From one end of a meter stick balance hang a pinch type clothespin by a thread. Inflate a balloon and fasten it shut with the hanging clothespin (do not tie the balloon shut). Refasten balloon to clothespin. Release balance and record observation and explain. The deflated balloon will be lighter, showing that air has weight.

c. From observations in experiments a and b draw a conclusion as to whether air is or is not matter.

d. Place a shiny can two-thirds full of cold water on the table. Fill the container the rest of the way with crushed ice. Observe the sweating of the can. (If no sweating occurs, add a little salt to the ice-water mixture and stir lightly.) Explain the source of the water on the can. This demonstrates that water vapor is one of the components of the air.

e. With candle wax, fasten a four to six inch long candle to the center of the bottom of a small aquarium (battery jar, refrigerator dish, or other similar container may be used.) Put two inches of water in the aquarium. Light the candle and place a 250ml or larger closed cylinder (need not be graduated) over the candle and resting on the bottom of the aquarium (if the cylinder does not have a pouring lip, place a paper clip under one edge to allow water to enter it freely.) Record your observations. After the water stops rising measure height of water in cylinder and record the measurement. Next, measure the total height of the cylinder. Record these measurements. The proportion of the part of the cylinder filled with water to the total height of the cylinder is the approximate proportion of oxygen in the air.

f. Obtain two test tubes the same size. Insert a wad of steel wool (it may need degreasing with dilute HCl) all the way down to the bottom of one of the test tubes. Pour some water into each test tube, shake well and then

pour off the water. Put each test tube, mouth down, into a wide-mouthed jar or beaker of water and fasten each test tube with a clamp. Have the mouth of each test tube the same distance (about one-half inch) below the surface of the water. Let the test tubes stand this way for twenty four hours.

Water will have risen up the test tube containing the steel wool. Nothing will have happened in the empty test tube, which serves as a control. Measure how high the water rose in the test tube and then measure the length of the test tube. Compare both lengths and you will find the water rose about one-fifth, or 20% of the way up the test tube. Note the rusty appearance of the steel wool. The steel wool combined with the oxygen in the air inside the test tube to form iron oxide (rust). Since the water rose one-fifth of the way up the test tube to replace the oxygen, this rising means that about one-fifth, or 20%, of the air in the tube was oxygen. The rest of the air is mostly nitrogen, with small amounts of inert gases, carbon dioxide and water vapor.

g. Hold a cool beaker (using tongs) just over a candle flame for several minutes. Record observations. Carbon on the beaker shows one of the solid pollutants in the air.

h. Hold the beaker (used in the last experiment) so the carbon is in the tip of the blue flame of a bunsen burner (most air maximum burning) for about five minutes.

Record observations and explain. The carbon slowly disappears as oxygen combines with it, changing it to carbon dioxide and carbon monoxide, both gases in the air.

4 Atmosphere and Earth's Rotation

On the board make a diagram of the earth's atmosphere, showing its height above the equator (1000 miles) and above the poles (500 miles). With a rotator and a set of centrifugal hoops, show how the rotation of the earth is responsible for the difference.

5 Layers of the Atmosphere

List on the board the four main layers of the atmosphere and describe each. Such a list follows:

a. Troposphere - from the Greek word "tropos" meaning "to mix." It is sometimes called the "weathersphere."
   1) Ground to about eleven miles over the equator
   2) Ground to about five miles over the poles
   3) All weather changes occur in this layer
   4) Temperature decreases with elevation about $3\frac{1}{2}^{\circ}$ F. for every one thousand feet.

b. Stratosphere - from the Greek word "stratos" meaning "to smooth out."
   1) From the top of the troposphere to about sixty miles above the earth
   2) Almost no cloud formation
   3) Continuous strong winds - jet stream
   4) No up and down currents
   5) Temperature constant - 70° F. up to 40 miles

6) Ozonosphere 40 miles to 60 miles up

7) Temperature at bottom of ozonosphere 170° F. but falls off rapidly from there up

8) Ozonosphere filters out large quantities of ultraviolet radiation from the sun

c. Ionosphere - from the Greek word "ion" meaning to have an electric charge

1) Gases are ionized

2) From 60 miles up to between 200 and 500 miles

3) Height varies from night to day

4) Caused by short wave radiation from the sun

5) Reflects radio waves

d. Exosphere - from the Greek word "exos" meaning "to go out."

1) From top of ionosphere to about 1000 miles up

2) Some molecules of the lighter gases leave the earth here, causing the earth to slowly lose its atmosphere

6 Air Affects Living and Nonliving

Assign certain pupils to make reports or lead class discussions on what the air does:

a. For animals

b. For plants

c. To rocks

d. To soil

In reports or during discussions list on the board what air does in each of the following cases:

a. What air does for animals:

1) Furnishes O_2

2) Carries away CO_2

3) Carries heat from the body

4) Evaporates H_2O from the body

5) Applies pressure to the body

b. What air does for plants:

1) Furnishes CO_2 when plant is in light

2) Furnishes O_2 when plant is in dark

3) Furnishes N_2 for legumes to put in ground

4) Carries pollen grains (insects do this also)

5) Carries seeds (animals do this also)

6) Carries water to them as rain, dew, show, etc.

c. What air does to rocks:

1) Causes decay of rocks by action of H_2CO_3 and O_2

2) Carries H_2O which causes rapid temperature changes by falling on hot rocks

3) Carries H_2O which freezes in cracks, causing rocks to break still more

4) Water vapor blanket holds back radiation, thus preventing great and rapid temperature changes

5) Causes mechanical wearing of rocks caused by sand blasting; transports mechanically worn rock material.

7 Carbon Cycle

Diagram the carbon cycle on the board and discuss.

8 Nitrogen Cycle

Draw a diagram on the chalkboard showing the nitrogen cycle.

Trace the conversion of free nitrogen in the air into nitrogen materials that plants and animals can use and then trace the conversion of the different nitrogen materials back into free nitrogen again.

9 Evaporation is a Cooling Process

Dip your forefinger into a tumbler of water. While keeping the wet forefinger and dry middle finger only a slight distance apart, blow on both fingers at the same time. As the water evaporates from the forefinger, the heat needed for evaporation is taken from the finger, leaving the finger cooler. The middle finger, which serves as a control, does not become cooler.

10 Hygrometer

Using a wet-dry bulb hygrometer, note the actual temperature drop due to the evaporation. Record observations.

11 Rate of Evaporation and Humidity

Compare the time it will take for the water in a wet cloth (or ten drops of water in a pie tin) to evaporate on a dry day when the humidity is low and on a damp day (or rainy) when the humidity is high. The greater the humidity, the more water vapor there will be in the air and the less opportunity there will be for more molecules of water to go off into the air.

The last three experiments show the cooling effects of air on animals.

12 Effect of Rapid Temperature Changes on Materials

Heat a piece of window glass or a glass bottle slowly by putting it in a container of tap water and heating until the water is boiling. Remove the glass and pour ice water on it. Record your observations.

This shows that rapid temperature changes caused by falling rain can break rocks.

13 Air - Weather and Climate

Have pupils report on the role of the air in determining our weather and climate and list on the board what air does in each case. The following lists are examples:

a. Role of air in weather

1) Moves as wind

2) Carries heat

3) Carries moisture

4) Up and down drafts produce static charges necessary for precipitation

b. Role of air in climate

1) Carries heat from one place to another

2) Carries moisture from one place to another

3) Controls loss of radiant heat from earth

4) Controls amount of radiant energy reaching surface

14 Atmospheric Pressure

Demonstrate atmospheric pressure in the following ways:

a. Put one or two tablespoons of water in a one gallon or larger rectangular can that can be sealed. Heat the can until steam is coming freely from the opening. Remove the heat, seal the can, let stand and observe. Record observations.

b. Have two pupils attempt to pull Magdeburg Hemispheres apart after air has been pumped out of them. Then open valves and let the pupils try again. Explain what happens in each case.

c. Push a small suction cup (from a dart or toy arrow) onto a

small sheet of glass. Time how long it takes cup to loosen. If it doesn't, stop timing after ten minutes. Reset cup and place under a bell jar on a vacuum pump. Remove air from beneath the bell jar and record observations. The cup will fall.

d. Make a mercurial barometer and measure actual atmospheric pressure. Use a barometer tube or a glass tube about 33 inches long and sealed at one end. Connect a funnel to the tube with a short piece of rubber tubing (do this over an empty aquarium so spilled mercury is not lost). Put your finger over the open end of the barometer tube and invert the tube into a small beaker about half full of mercury (do not remove your finger from the tube until the open end is below the surface of the mercury in the beaker). Fasten the tube in its position with a ring stand and clamp. Using a meter stick (or yardstick) measure height of column of mercury in the tube above the mercury surface in the beaker. This is the atmospheric pressure in millimeters or inches of mercury.

c. Air Barometer

Make a barometer. Obtain a milk bottle or a glass jar with a medium to narrow mouth. Cut out the dome-shaped end of a rubber balloon and stretch the rubber tightly around the mouth of the jar, fastening the rubber sheet securely with a rubber band. Flatten both ends of a soda straw and cut one of the ends to a sharp point. Place rubber cement or glue on the flattened end of the straw and attach the flattened end to the middle of the rubber sheet. Cut a tiny piece of wood

from a match and glue it at the edge of the rubber sheet so that the straw rests on top of the wood. When the air pressure in the room increases, the rubber sheet is pushed down, making the straw move up. When the air pressure in the room decreases, the greater air pressure inside the bottle now pushes the rubber sheet up, making the straw move down. A cardboard scale will help pupils see the change in air pressure. Calibrate the marks on the cardboard scale with the reading on a standard barometer. Keep the barometer in a place as free from temperature change as possible. Otherwise the air inside the bottle will expand and contract, pushing the rubber sheet in and out. Have pupils take barometer readings each day for two weeks or a month and predict the weather on the basis of rising or falling air pressure.

15 Effect of Temperature on Air Mass

Place a meter stick balance on a chair or stool. With a thread taped to the bottoms of two large, opened paper bags, hang the bags from the meter stick, one at each end so the system is balanced. Place a 100 watt light just under the opening of one of the bags. Record observations and explain

This experiment demonstrates that warm air is lighter than cold air.

16 Variations in Air Density

List on the board causes of variations in density of air, and thus, variations in atmospheric pressure.

a. Variations in density of air caused by:

1) Temperature

2) Altitude

3) Water

4) Pollutants

b. Differences in temperature caused by:

1) Differences in the specific heat of substances with which the air is in contact

2) Differences in absorption and reflection of substances with which the air is in contact

3) Clouds

17 Absorption of Radiant Heat

Obtain two tin cans of exactly the same size. Paint the outside of one can with flat, black paint and paint the outside of the other can with white paint. Now add equal amounts of water into each can so that the cans are about one half to three fourths full. Place a thermometer in each can (the thermometers must have the same reading) and place both cans in the sunlight. If there is no sunlight place each can the same distance (6 to 10 inches) from a 100 watt lamp. Record the temperature reading every fifteen minutes for one hour. The water in the black can will become warmer than the water in the white can.

18 Convection Currents

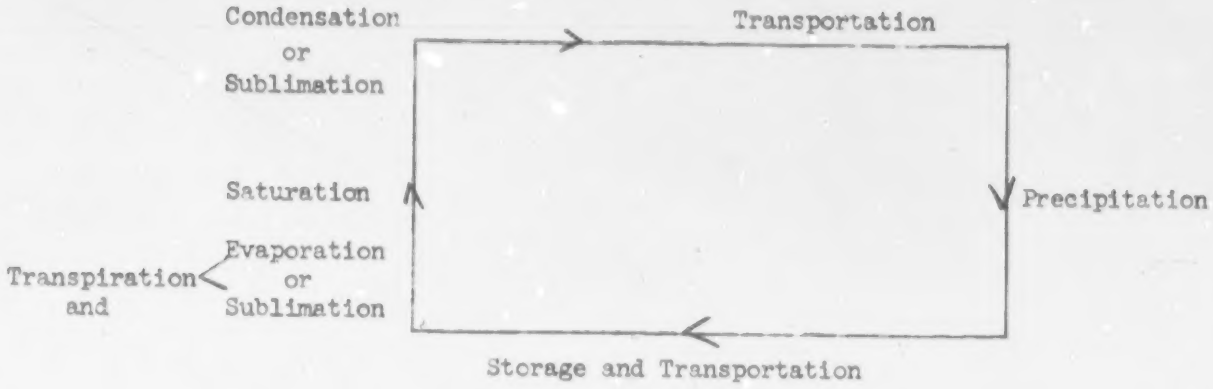
Diagram on the board and explain convection currents.

19 Air Mass Movements in the Atmosphere

Using a circle drawn on the board to represent the earth, draw six convection loops and the six belts of prevailing winds. Explain the Coriolis effect.

20 Water Cycle

Diagram and explain the water cycle.



21 Relative Humidity

Measure the relative humidity with a sling psychrometer or wet-dry bulb hygrometer.

22 Fog

Fill a clean, dry milk bottle (or any other bottle with a narrow neck) with very hot water slowly to prevent the glass from cracking. Now pour out most of the water, leaving one or two inches in the bottom. Put an ice cube on the mouth of the bottle and hold the bottle between you and the sunlight or the light of a lamp. A fog will form in the bottle as the warm, numid air is cooled by the ice cube and the cool air below the ice cube, and the water vapor condenses in tiny droplets that float in the air.

23 Make a Cloud

Put a two hole stopper in a 500 ml or larger flask. Put a glass "L" tube in each hole of the stopper and put a short rubber tube with pinch clamp on each "L." Put an inch of water in the flask. Open both pinch clamps, light a match and inhaling on one tube

draw smoke from the burning match into the flask. Close the pinch cock by the match. Increase the pressure in the flask by forcing air into the flask (using lung power). Release the pressure and observe the cloud formed in the flask. Increase the pressure again and the cloud will disappear.

Increased pressure heats the air. Warm air can hold more water so cloud disappears. Decreasing the pressure lowers temperature, saturating the air, and cloud forms.

24 Make a Hair Hygrometer

Obtain a piece of two-by-four about a foot long. Set it upright. Fasten a cardboard pointer loosely near the bottom end of the board with a tack put through the broad end of the pointer. Make sure the pointer will swing freely. Obtain a blond hair about ten inches long. Wash it in carbon tetrachloride to remove the oil. With tape or glue fasten one end of the hair near the top of the two-by-four and the other end of the hair to the pointer just ahead of the tack so the pointer is held horizontal. This hygrometer can then be calibrated against a wet-dry bulb hygrometer.

25 Relative Humidity and Comfort

Have a pupil report on the effects of two much or too little relative humidity. List the effects on the board.

26 Forms of Precipitation

List the forms of precipitation, defining them and explain the conditions necessary for the formation of each. Such a list follows:

a. Rain-drops of water falling from sky

1) Condenses out of air above 32° F.

2) Electricity makes drops bigger

3) Drops must be heavy enough to fall against the updraft

b. Snow- ice crystals falling from sky

Condenses from air below 32° F.

c. Mist- a very fine rain - no updraft

d. Sleet- frozen rain drops

1) Starts as rain

2) Falls through layer of air with a temperature below freezing.

e. Hail- layered balls of ice falling from sky

1) Starts as sleet

2) Blown back up to take on a new layer of water which in turn freezes

3) Hail formed in layers

f. Dew- water condensed on surfaces which are colder than the air but above freezing

g. Frost- water condensed on surfaces which are colder than the air and below freezing

h. Glaze- rain frozen on the ground

1) Air temperature above freezing

2) Ground temperature below freezing

27 <u>Demonstrating Electrical Effects on Rain Production</u>

Make about a one inch radius 180° bend twelve inches from the end of a forty inch piece of glass tubing. Eighteen inches from this bend make another similar bend away from the first to form an S. Partially heat-seal the tube at the short end to form a small hole.

Place a one-half gallon milk bottle full of water on a stool or chair. Put the long end of the glass tube in the water and start it siphoning. (Have the water discharge into a sink or tray.) Inflate a balloon and charge it by rubbing it on wool. Starting ten feet from the fountain, bring the charged balloon near. Record observations.

The droplets are charged by induction and coalesce to fall as a continuous stream. This shows how droplets in a cloud are made big enough to fall by the action of electricity in the air.

28 Weather Factors

List on the board those things which effect the weather.

a. Large bodies of water - cause winds and moist air
b. Local winds
c. Planetary winds
d. Jet stream
e. Ocean currents
f. Altitude
g. Latitude

29 Climatic Factors

List on the board those things which effect the climate.

a. Land masses
b. Mountains
c. Nearness to large bodies of water
d. Ocean currents
e. Prevailing winds
f. Altitude
g. Latitude

30 Weather Instruments

List on the board the instruments used in determining and predicting weather. Such a list follows:

a. Atmospheric pressure measuring instruments

1) Mercurial barometer

2) Anaroid barometer

3) Barograph

b. Wind direction measuring instruments

1) Wind vane

2) Wind sock

3) Weather balloon

c. Wind velocity measuring instruments

1) Anemometer

2) Kite wind gauge

3) Wing wind gauge

4) Propeller wind gauge

5) Pitot tube

6) Weather balloon

d. Humidity measuring instruments

1) Hair hygrometer

2) Wet - dry bulb hygrometer

3) Sling psychrometer

4) Recording hygrometer

e. Temperature measuring instruments

1) Thermometer

2) Thermograph

f. Cloud measuring instruments

1) Ceilometer

2) Nephoscope

3) Weather balloon

g. Precipitation measuring instruments

1) Rain gauge and tipping bucket

2) Ruler

h. Special, combined instrument

Radiosonde

31 Cloud Types

Show pictures of the four basic clouds and explain what each means weatherwise. List these on the board.

a. Cirrus - high 25,000 ft. or higher, thin wispy, made of ice crystals - mean change in the weather

b. Cumulus - piled up, puffy - usually means fair weather

c. Stratus - low, uniform sheet, bring slow, steady rain or snow

d. Cumulo nimbus - really a piled up cumulus with flat base and anvil shaped top - brings storms

32 Weather Maps - Weather Factors Listed

Using a weather map, list those things effecting weather recorded on it.

33 Weather Fronts

Make diagrams on the board showing the following fronts with the types of clouds and weather associated with them.

a. Warm front

b. Cold front

c. Stationary front

d. Occluded front

34 Cold and Warm Fronts

Watch for the appearance of fronts, using the weather forecast as a guide. When a front begins to move in, keep a record of the weather conditions. Continue this record until the front has passed. Draw on the chalkboard diagrams of the movement of a cold front and a warm front, showing the kinds of clouds and precipitation that are formed in each case.

35 Storms

Have students report on the main types of storms giving descriptions and causes.

36 Tornado - Model Vortex

Obtain an electric drill and a paint mixer for same. Fill a round battery jar or a 500 ml. or larger beaker two-thirds full of water. Use the electric paint mixer to spin the water in the container. Record observations.

Funnel vortex is same as in tornado.

37 Bernoulli's Principle

a. Holding a sheet of paper (about twelve inches long and three or four inches wide) at one end, blow over the top. Record observation.

   This demonstration illustrates Bernoulli's principle, the principle by which a heavier than air craft is supported.

b. Support a ping pong ball on a narrow stream of air from the exhaust of a vacuum pump or vacuum cleaner. This also demonstrates Bernoulli's principle.

38 Use of Air to Reduce Friction

Use a frictionless puck to demonstrate how air can be used to reduce friction and support vehicles such as the hover-craft

or air cushion cars.

39 Air Pollution

Have pupils list the different ways that the air is being polluted in this community. Find out what measures the community has taken to control air pollution. Discuss the causes of smog, its effects and methods of reducing or eliminating it. Have pupils report on radioactive fallout and the dangers that may result from an excess of this kind of air pollution.

Suggested Field Trips

1. Local weather station
2. Cincinnati Air Pollution Center
3. Airport weather facilities

See Field Trips in Geology Unit on Erosion

Selected References

Books from the public or school libraries:

Barnes, Charles C. Exploring Our World. Lippincott

Beauchamp, Wilmar L. Science Problems. Scott and Foresman

Bendick, Jeanne. Lightning. Rand McNally

Brindye, Ruth. The Story of the Trade Winds. Vanguard

Britton, Katherine. What Makes it Tick? Houghton

Comstock, Anna B. Handbook of Nature Study. Comstock

Curtis, Mary I. Conservation in America. Lyons and Carnahan

Gaer, Joseph. Everybody's Weather. Lippincott

Hitte, Kathryn. Hurricanes, Tornadoes and Blizzards. Random House

Meister, Morris. The Wonderful World of Science. Scribner

Meyer, Jerome S. Picture Book of the Weather. Lothrop

Parker, Bertha M. Ask the Weather Man. Row and Peterson

Parker, Bertha M. Clouds, Rain and Snow. Row and Peterson

Parker, Bertha M. Thermometers, Heat and Cold. Row and Peterson

Parker, Bertha M. Ways of Weather. Row and Peterson

Parker, Bertha M. Balance in Nature. Row and Peterson

Peet, Creighton. How Things Work. E. M. Hale

Pickwell, Gayle B. Weather. McGraw

Powers, Samuel R. Our World Changes. Ginn

Powers, Samual R. Exploring Our World. Ginn

Schneider, Herman. Everyday Weather and How it Works. McGraw

Sears, Paul. This Useful World. Scott and Foresman

Selected Films

63 Climates of North America

93 Weather: Understanding Storms

208 Origins of Weather

280 What Makes Clouds

281 What Makes the Wind Blow

715 Problems of Conservation

1169 Aerodynamics - Theory of Flight

1227 Weather

1343 Airscrew

1411 What Makes Rain

1597 What Makes Things Float

1818 Story of A Storm

1824 How Weather is Forecast

2052 Our Weather

2164 Climate and The World We Live In

2241 Science of The Sea

2340 Exploring the Edge of Space

2408 Origin of Weather

2431 Oceans of Air

2432 Weather Scientists

2452 Dust Bowl

2474 Life in Hot Rain Forests

2475 Life in the High Andes

2491 An Airplane Trip by Jet

2601 Unchained Goddess

Filmstrips

6173 Human Respiration

6199 Weather and Seasons

6200 Climate and Plants

6415 How Airplanes Fly

6434 Exploring the Air

6435 Putting Air to Work

6440 Exploring Weather Fronts

6441 What Weather Fronts Bring

6581 Men and Wings

6582 Today's Wings

6597 The Air Ocean

6598 Air Masses

6776 Weather

6788 Buoyancy and Archimedes' Principle

6791 Atmospheric Pressure

6792 Exploring the Atmosphere - Streamline Flow

6793 Barometers and the Weather

6796 Bernoulli's Principle

6948 Why Does the Weather Change

6949 Why Does the Wind Blow

Recordings

9831 Our Friend, the Weatherman

9996 Meteorology

Sources of Free and Inexpensive Materials

1. Air Transport Association of America
   1107 16th Street, N.W., Washington, D.C. (6)

2. New York Life Insurance Company
   51 Madison Avenue, New York, New York 10010

3. Institute of the Aeronautical Sciences
   2 East 64th Street, New York, New York 10021

4. American Society of Agricultural Engineers
   St. Joseph, Michigan

5. Michigan Employment Security Commission
   7310 Woodward Avenue, Detroit, Michigan (2)

6. Science Research Associates
   57 W. Grand, Chicago, Illinois (10)

7. Occupational Outlook Handbook, Superintendent of Documents
   Washington, D. C. (25)

8. American Meteorological Society
   3 Joy Street, Boston, Mass. (8)

9. Cincinnati Water Works

CAREERS RELATED TO ATMOSPHERE

METEOROLOGISTS

Studies and interprets atmospheric conditions and related meteorological data to forecast immediate and long range changes in weather: Analyzes and interprets synoptic charts, maps, prognostic charts and meteorological data, such as barometric pressure, temperature, humidity, wind velocity and areas of precipitation, to make forecasts. Investigates meteorological aspects of radio propagation, aurora and air glow and cosmic rays. Conducts research into long range forecasting, severe weather phenomena, solar heating and other problems. Draws isobars on surface maps, indicating fronts, areas of precipitation, high and low barometric pressure and falling and rising pressure and predicts movements of fronts, precipitation and pressure areas. Advises airplane pilot, commercial and other flight personnel regarding meteorological data, such as winds aloft, ceilings, visibility, icing conditions, thunderstorms, and other forms of turbulence and movements of cloud formations.

CLIMATOLOGISTS

Interprets statistical data on wind, rainfall, sunshine, temperature and other aspects of climate of a particular area over extended periods of time to predict future climatic conditions. Develops and utilizes statistical and other methods to analyze and interpret climatological data.

WEATHER OBSERVER

Observes and records weather conditions for use in forecasting: Periodically observes general weather, sky and visibility conditions; reads weather instruments including thermometers, barometers and hydrometers to ascertain elements, such as temperature, barometric pressure, wind velocity, visibility and precipitation. Calculates winds aloft by following balloon's ascent with theodolite, recording angles of azimuth and elevation at specific time intervals

and converting readings into wind speed and direction, using charts and mathematical tables. Decodes weather data received by teletypewriter and plots synoptic charts of large geographical areas, such as North America.

INDUSTRIAL-HYGIENE ENGINEER

Plans and coordinates private or government industrial health program requiring application of engineering principles and technology to analyze and control conditions contributing to occupational hazards and disease. Conducts plant or area surveys to determine safe limits of exposure to materials or conditions, such as temperatures, noise, dust, fumes, vapors, mists, gases, solvents and radiation, which are known or suspected of being real or potential detriments to health and implements or recommends control measures. Directs workers engaged in field and laboratory verification of compliances with health regulations. Provides technical guidance to management, labor organizations, government agencies and civic groups regarding health-related problems, such as stream and air pollution and correct use of protective clothing or accessories.

ASSOCIATED OCCUPATIONS

AIRLINE AGENTS: May issue tickets, check baggage, answer inquiries, keep records, and/or handle reservations.

AIRLINE FLIGHT ENGINEERS: Assist captain and copilot on certain flights of larger commercial airplanes. Watch and keep logs on engine performance, make preflight check, etc.

AIRLINE GROUND RADIO OPERATORS AND TELETYPISTS: Relay or transmit communications between ground stations and flight and ground personnel. May make minor repairs. Use radiotelephone, radiotelegraph and teletype machine.

AIRLINE PILOTS AND COPILOTS: Operate controls of plane as well as many other flight tasks.

AIRLINE STEWARDESS: Responsible for passengers comfort. May check tickets, give instructions, answer questions and serve food. May need to speak foreign languages.

ARCHITECTS: Plan and design buildings and supervise construction. Constructions built are influenced by local weather condition.

AERONAUTICAL ENGINEERS: Work primarily on design and structure of aircraft and missiles.

AIRPLANE MECHANICS: Service, inspect and overhaul airplanes.

AIR CONDITIONING AND REFRIGERATION MECHANICS: Install, maintain, service refrigeration and air conditioning equipment.

See careers in other units on:

Fishermen

Farmers

Geologist

Civil and Agricultural Engineers

UNIT XIV

EARTH AND THE HEAVENS

ACTIVITIES

No. of Activity

1 Tides

Obtain a piece of white poster board eighteen by twenty four inches, a roll of absorbent cotton, a bottle of blue ink and some glue or household cement. On the poster board draw a circle six inches in diameter, and paint the word earth inside the circle. Roll and shape some absorbent cotton until it looks like a doughnut three inches thick, which will fit around the circle, and glue the cotton to the poster board. After the glue has set, pour the blue ink on the cotton to give the effect of blue waters. Tape the poster board securely to the chalkboard.

Cut out a paper circle three inches in diameter and write the word moon on it. Also tape the "moon" to the chalkboard to the right of the "earth." Now gently pull the cotton on the side of the "earth" nearest the "moon." A bulge that shows the formation of a high tide will form. Gently pull the cotton on the side farthest from the "moon" to produce a second high tide. The top and bottom of the cotton circle will flatten out to form two low tides.

If you want to show how spring tides and neap tides are formed, cut out another circle and write the word sun on it. Place the "sun" to the right of the "moon" and create a spring tide effect

with the cotton. Then place the "sun" above the "earth" at right angle to the "moon" and create a neap tide effect with the cotton.

2 Solar and Lunar Eclipses

Let a source of light represent the sun. This source can be a gooseneck or table lamp with the shade removed, a slide projector, or a powerful flashlight. Get a globe of the earth and position the globe and light source so that the light falls evenly on the globe when the room is darkened. Let a tennis ball represent the moon. Hold the tennis ball between the "sun" and the "earth." The ball may have to be moved back and forth until a sharp shadow forms on the globe. Observers on earth in this shadow would see a solar eclipse.

To show a lunar eclipse, hold the tennis ball or "moon" on the far side of the "earth" so that the "earth" is between the "sun" and the "moon." Move the ball back and forth until the "moon" is completely within the earth's shadow, forming a lunar eclipse. Move the ball around the globe in a slightly tilted orbit to show that most of the time the shadows of the moon and earth are either too high or too low to produce an eclipse.

3 Stars Differ in Color

Heat a piece of wire until it glows. It will glow orange at first. As it becomes hotter, it will glow yellow. Turn on a table or gooseneck lamp, with the shade removed, that has a light bulb of clear glass so that the wire inside can be seen. The extremely hot wire will glow a yellow white. Point out that our hottest stars are blue-white and white and, as they become

cooler, they turn yellow, orange and then red.

4 Make a Bulletin Board Exhibit of Constellations

Cover the bulletin board with dark blue paper or cloth. Paste silver stars to show the constellation patterns. White ink can be used, if desired, to draw the figures represented by the constellations. In many popular books on astronomy these constellations are well illustrated. Put up the summer constellation in the early fall, and the winter constellations later in the year. Have pupils become familiar with the constellations of the zodiac.

5 Collect Pictures of the Stars

Look for and collect pictures of stars, double stars, different variety of star clusters, nebulae, and galaxies.

6 The Galaxy

On a clear night, as far away from the lights of the city as possible, locate the milky way in the sky.
Binoculars or a small telescope will help. Look for a picture of the galaxy. Show the position of the sun and the solar system in the galaxy. Point out the differences in the speed of the stars in the galaxy.

7 The Earth's Layers

Get a styrofoam ball at least eight inches in diameter, or larger if possible. These balls are now sold as decorations for Christmas trees. By using a sharp knife, cut a good-sized wedge out of the ball so that the inside of the ball can be seen to the center. By using a soft pencil, draw lines on the inside of the ball to show the relative thickness of the earth's

layers. Note that the relative thickness of the earth crust will have to be exaggerated. Color these thicknesses with different colored wax crayons. Rough cutouts of some of the earth's continents can be pasted on the outside of the ball to give the illusion that it is a model of the earth.

8 Examine Sand

Examine sand closely through a strong magnifying glass. Note the presence of different minerals, with differences in color, shape and size. The colorless glassy crystals are quartz. Red crystals are usually garnet. Flaky black crystals may be mica or biotite. Rectangular black crystals are probably hornblende. If there are black crystals that are attracted to a magnet, they are most likely magnetite. Green crystals may be olivine, and purple crystals may be amethyst.

9 Ground Water Dissolves Limestones

With a can opener remove the top and bottom of a tin can. Cover one end of the can with a piece of cotton cloth or several layers of cheesecloth and fasten the cloth securely to the sides of the can. Fill the can with crushed limestone. While holding the can over a shallow saucer, pour distilled water or freshly collected rainwater into the can. Collect a sizable quantity of the water that has passed through the can and fallen into the saucer. Place the saucer, together with another saucer of the same size and containing an equivalent amount of distilled water or rainwater, in a quiet place. Allow the water in both saucers to evaporate completely. The water that passed through the limestone will leave behind a coating of limestone when it evaporates.

WORKSHEET 6a

EARTH AND THE HEAVENS

NAME _____

DATE _____

Name of Star	Constellation	Position	Time	Date	Remarks
		210			

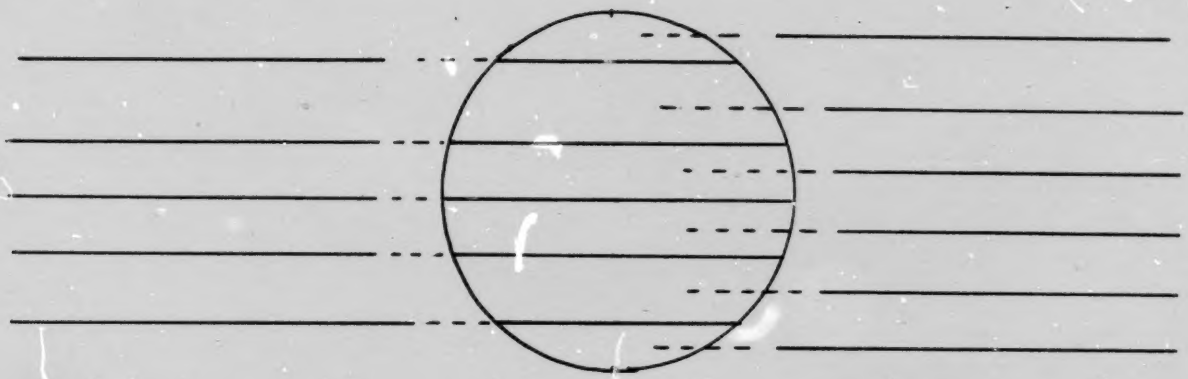
WORKSHEET 7a

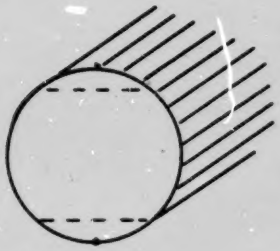
Earth - Layers

NAME _____

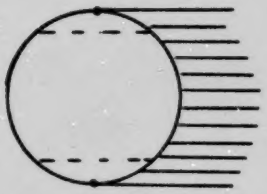
DATE _____

Directions: Fill in the blanks





DATE: _____



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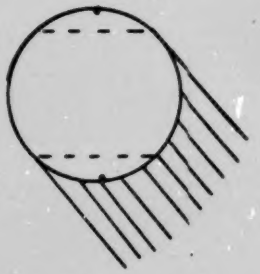
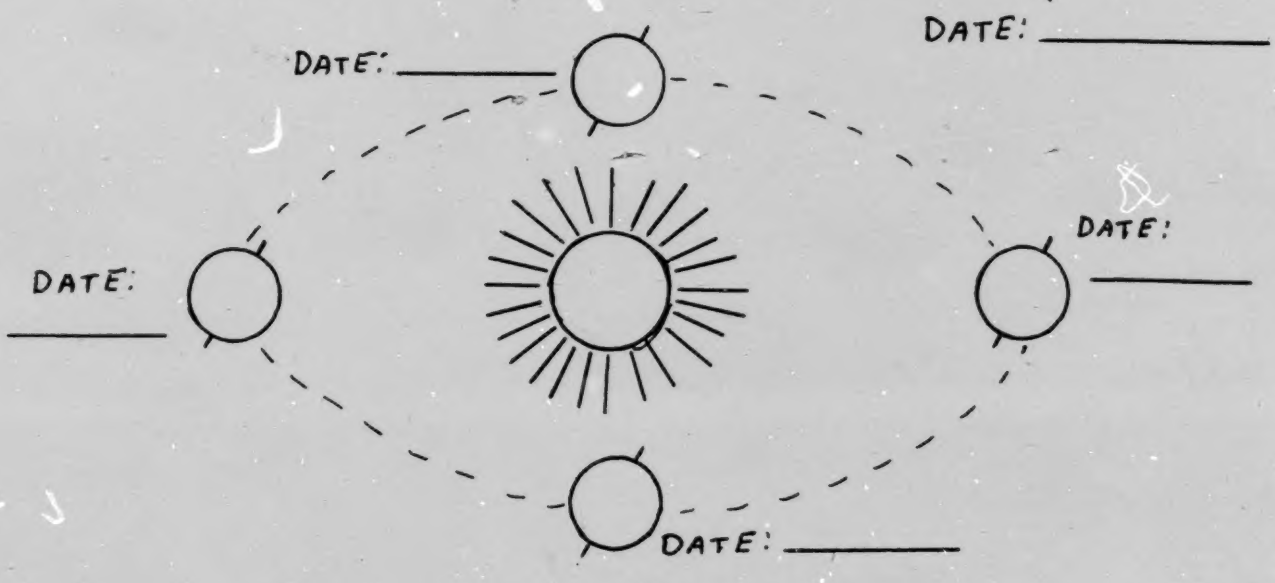


DATE: _____



10 Caves

Show pictures of caves or caverns that have been formed by the action of ground water, containing carbon dioxide, on the limestone. If possible, visit a nearby cave and examine its formation.

11 The Constellations Change their Position in the Sky

Observe the position of well-known constellations, such as the Big and Little Dippers or Orion, early in the evening and then later in the evening. Their positions will have changed. This apparent change is caused by the earth's rotation. Observe their position one night each week for four weeks at the same time each night. Again their position will have changed. This apparent change is caused by the earth's revolution around the sun. An excellent star chart, called the "Star Explorer," can be obtained inexpensively by writing to Star Explorer, Hayden Planetarium, New York, New York 10024. It has excellent instructions and can be adjusted for different times of the year. Use this star chart to locate the constellations in the sky.

Selected References

Andrews, Roy Chapman. This Amazing Planet. New York: Putnam, 1950,231 pp.

Baker, Robert H., Introducing the Constellations. New York: Viking, 1957.

Baker, Robert H., When the Stars Come Out. New York: Viking, 1957.

Baker, Robert H., The Moon Seems to Change. New York, 1960

Hawkins, Gerals S., Splendor in the Sky. New York: Harper, 1961, 292 pp.

Texerear, J., How to Make a Telescope, Interscience, 1957.

Zinner, E., The Stars Above Us. Scribner, 1957.

Speakers

Health Careers Association of Greater Cincinnati

Community Resources Service Program, Cincinnati Public Schools, Education Center.

Suggested Field Trips

Museum of Natural History

Libraries - Public

Suggested Films

4	Constellation, Guide to the Night Sky	11 minutes
6	First Men into Space	16 minutes
18	Our Changing Earth	13 minutes
148	Meteors and Planetoids	11 minutes
1808	The Solar System	10 minutes
2144	Understanding our Universe	11 minutes
2218	Exploring the Night Sky	13 minutes

Suggested Filmstrips

6436	Exploring the Sun
6437	The Sun at Work
6492	The Moon
6490	Astronomy Through the Ages
6493	The Stars
6463	The Sky above our Earth

UNIT XV

PLANES, ROCKETS AND SPACE TRAVEL

ACTIVITIES

No. of Activity

1 Effect of Wingspread on Lift

Obtain two model planes, one with a largeer wingspread than the other. Point out that the greater the wingspread, the more air passes over and under the wings, and the greater the lift will be.

2 The Propeller Produces a Thrust

Examine the propeller of a model plane and note the curve of the blades. The blades are curved in such a way that, as the propeller spins, they push the air backward thus producing an opposite forward thrust. Place a series of round pencils underneath a flat board. Then put a small electric fan (with a long extension cord) on top of the board. Turn on the fan. The fan blows air in one direction and, as a result, moves in the opposite direction.

3 Parts of a Plane

Have a pupil bring in a model plane and point out the parts of the plane and their functions. If possible, conduct a field trip to a nearby airport. This trip will give pupils an opportunity to observe and study first hand the different kinds of planes, their parts and functions, the plane instruments and their functions, the way the runways are arranged, the safety devices on the landing field, the control tower, directions for take-off and landing, the refueling of planes, the loading and unloading of cargo and passengers and the different kinds of weather instruments. Have the pupils observe the various occupations.

4 The Sound Barrier

Blow up a paper bag and strike it suddenly, causing the bag to burst with a loud noise. Point out that a shock wave was produced that is similar to that of passing through the sound barrier.

5 The Helicopter

Obtain a model of a helicopter. Point out that the spinning propeller pushes the air downward, producing a reaction or thrust that forces the helicopter upward.

6 Principle of Rocketry

Illustrate Newton's third law of motion. Fill a balloon with air. For the air to escape from inside the balloon, air molecules have to exert an action force. They push against each other and against the inside wall of the balloon. As the air pushes against the balloon wall, the balloon pushes back with a reaction force. As the air is forced out, the balloon moves forward due to an unbalanced force in the forward direction.

7 Facts and Terms About the Apollo Program. See worksheet 7a.

8 Drawings of Structures of Apollo and Saturn V Rocket.

See worksheet 8a.

9 Illustrate Fuel and Oxidizer

Equipment: Asbestos pad, tripod stand, Bunsen burner, sulfur, charcoal, potassium nitrate (KNO_3) and gunpowder.

Fuels are sulfur, charcoal.

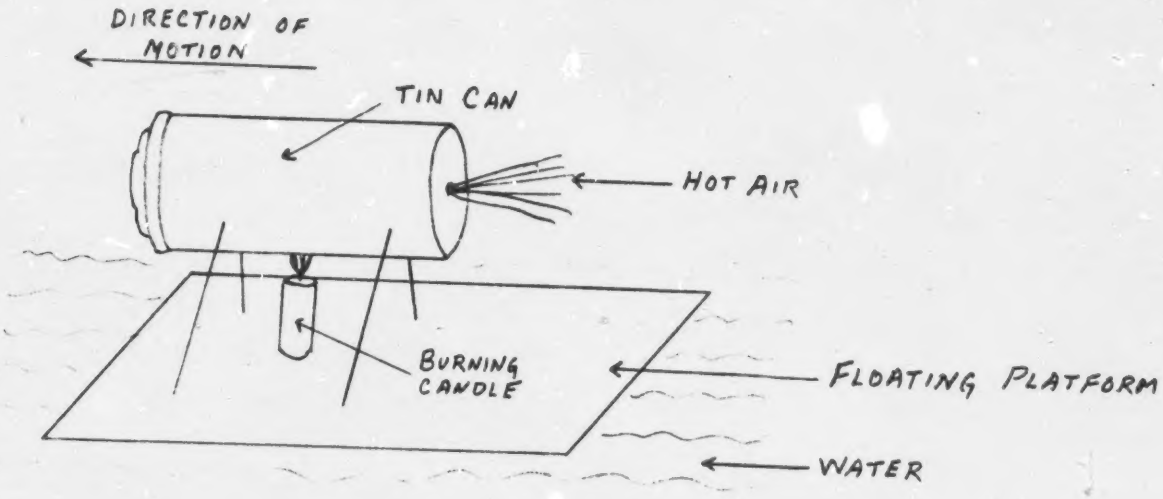
Oxidizer: potassium nitrate.

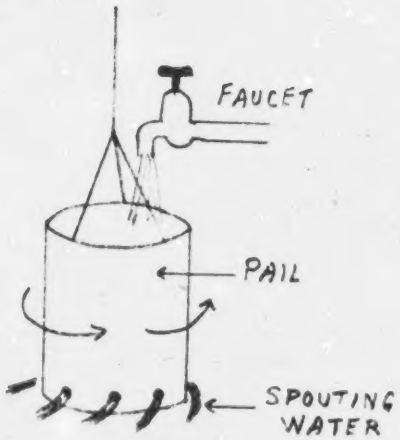
Use small quantities of sulfur and potassium nitrate and of charcoal and potassium nitrate. Heat each mixture on the asbestos pad and observe the reaction.

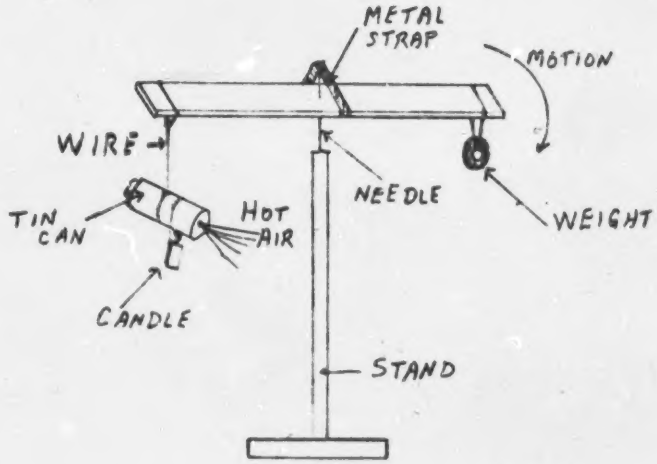
Explain that fuel will still burn without air because potassium nitrate (KNO_3) has oxygen in its compound. If possible, use a small amount of gunpowder in place of the mixture and repeat. Safety should be practiced.

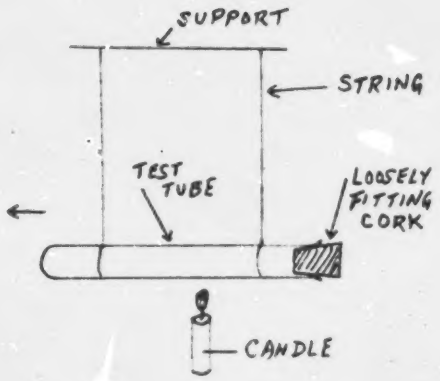
10 Ignition of Rockets

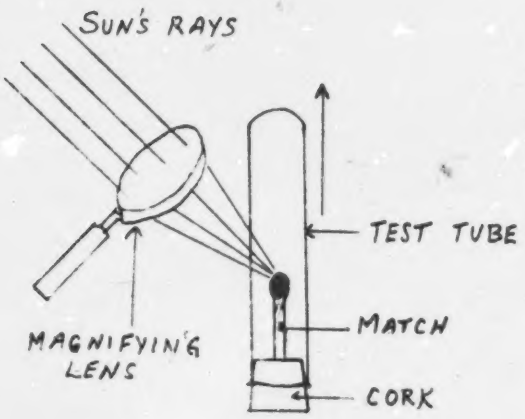
Ignite rockets (models) that you have or class members have. Safety, size of ignition area, weather, etc. should be considered. Estes Industries rockets, engines, power supplies, etc. are excellent products. (See the Board of Education Policy in Rocketry).

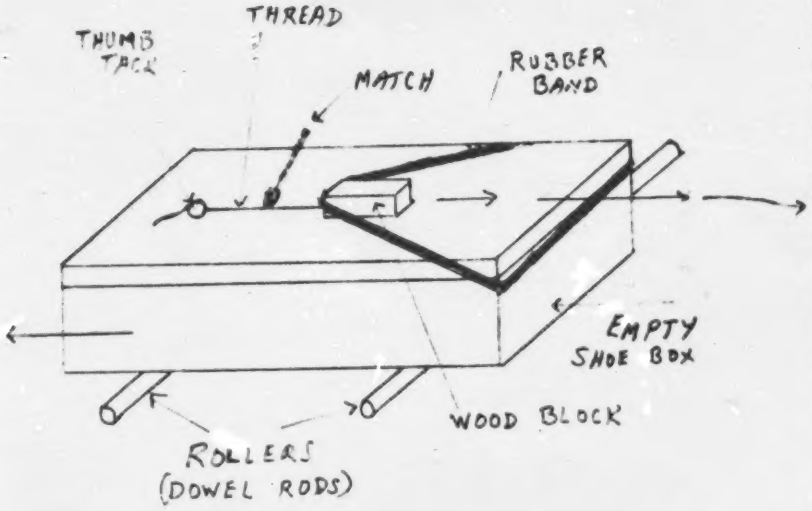

DIRECTION OF MOTION
TIN CAN
HOT AIR
BURNING CANDLE
FLOATING PLATFORM
WATER

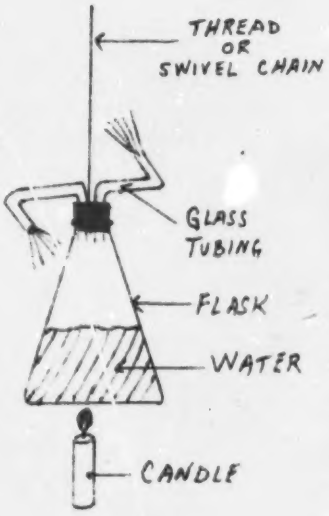

FAUCET
PAIL
SPOUTING WATER


METAL STRAP
MOTION
WIRE
NEEDLE
WEIGHT
TIN CAN
HOT AIR
CANDLE
STAND


SUPPORT
STRING
TEST TUBE
LOOSELY FITTING CORK
CANDLE


SUN'S RAYS
TEST TUBE
MATCH
MAGNIFYING LENS
CORK


THUMB TACK
THREAD
MATCH
RUBBER BAND
EMPTY SHOE BOX
WOOD BLOCK
ROLLERS (DOWEL RODS)


THREAD OR SWIVEL CHAIN
GLASS TUBING
FLASK
WATER
CANDLE

WORKSHEET 7a

MANNED SPACE FLIGHT: APOLLO

NAME_____

DATE_____

Apollo is the third step in NASA's manned space flight program. Its goals:

- To land American explorers on the moon and bring them safely back to earth
- To establish the technology required to meet other national interests in space
- To achieve pre-eminence in space for the United States

Apollo was preceded by Project Mercury which pioneered the technology and man's capabilities for manned space flight and by Gemini which significantly extended the technology and experience gained through Mercury. Both Mercury and Gemini were programs in which astronauts test-piloted spacecraft which were largely experimental. Apollo, on the other hand, calls for an operational spacecraft capable of carrying astronauts safely to and from another body in the solar system.

LUNAR ORBIT RENDEZVOUS

Three methods were considered to accomplish the manned lunar landing mission. They were:

- Direct flight of a full-size spaceship from the earth to the moon and back
- Launching two separate sections of a spaceship from earth into orbit, joining them together, and sending them as a single spacecraft to land on and take off from the moon
- Launching the whole spacecraft from earth to lunar orbit and landing a section of the craft on the moon while the other part waits in orbit for the landing craft to return. The third method, called lunar orbit rendezvous, was chosen after careful study.

WORKSHEET 7A (Continued)

The Apollo spacecraft assembly is eighty-two feet tall and weighs about forty-five tons. It is composed of three modules (separate units or blocks), plus an adapter and a launch escape system.

The command module is the only module designed to return to earth from the lunar mission. It contains the crew's living compartment and all the controls for the various inflight maneuvers. It consists of two shells: a pressurized inner crew compartment and an outer heat shield.

On top of the command module at launch is the launch escape system. The launch escape system is designed to separate the command module from the rest of the launch vehicle should an emergency occur on the launch pad or shortly after lift-off.

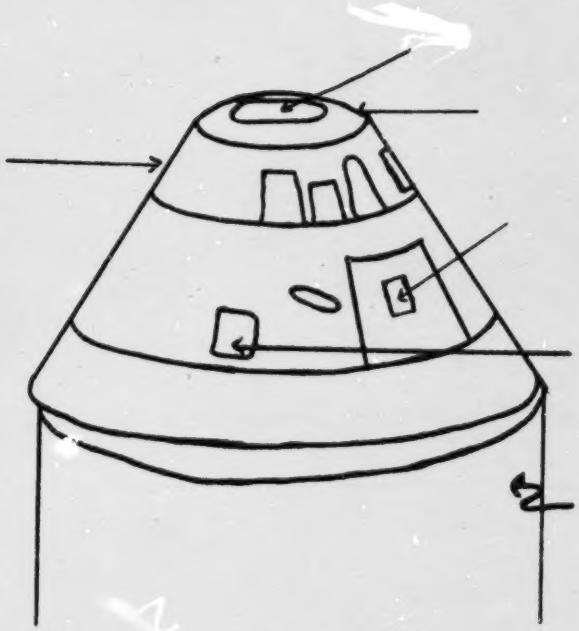
Beneath the command module at launch is the service module. It contains the spacecraft's electrical power supply equipment and its primary propulsion system. This stop-and-restart engine is used for several important maneuvers while the spacecraft is moonbound. It is also used to slow the spacecraft to go into lunar orbit and to make midcourse corrections while earthbound.

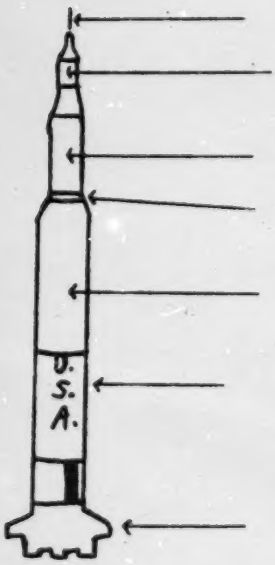
Under the service module is the adapter section which connects the Apollo spacecraft to the third stage of the Saturn V launch vehicle and serves as the housing for the Lunar Module, the lunar landing vehicle.

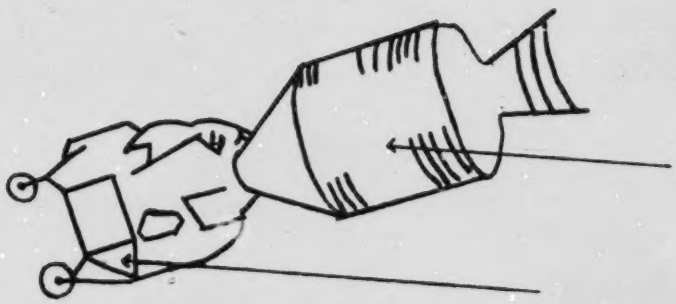
The lunar module is the flight unit that detaches from the orbiting command and service modules and descends to the moon's surface with two of the three austronauts aboard.

WORKSHEET 7a (Continued)

The Aoollo launch vehicles are the Saturn V rockets, consisting of three stages. The first stage has a cluster of five F-1 engines, each developing 1.5 million pounds of thrust, for a total of 7.5 million pounds. The second stage has a cluster of five J-2 engines that furnish a total of one million pounds of thrust. The third stage produces 200,000 pounds of thrust from one engine.




U.S.A.



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11 Problems of Space Flight

Have pupils report on such problems of space flight as getting enough thrust, escaping the earth's pull of gravity, landing on and leaving the moon or another planet and returning to and landing on the earth.

12 Problems of the Astronauts

Have pupils report on the problems of survival the astronauts have and will encounter in space travel. These problems include the tremendous force of acceleration and deceleration, weightlessness, food and water, sufficient oxygen, disposal of carbon dioxide and of body wastes, heat and cold, bombardment by cosmic rays and other deadly radiations, bombardment by meteors and mental problems caused by prolonged isolation.

13 Why Rockets are Launched Toward the East

Use cellophane tape to attach a small cardboard cutout of a rocket to a globe of the earth. Spin the globe from west to east, in the direction of the earth's rotation, and show how the earth's speed of rotation gives the rocket an extra push of about 1000 miles per hour, which helps the rocket reach the speed it needs to go into orbit.

Selected References

Branley, Franklyn M., A Book of Moon Rockets For You, New York, Crowell, 1959

Cooke, David C., How Airplanes Are Made, New York, Dodd, 1957

Dietz, David, All About Satellites and Space Ships, New York, Random, 1962

Suggested Films

Catalog Number	Title	Time
2244	Rockets: Principles and Safety Rocket and the Physical Principles Which Make Rocket Motors Work (color)	11 minutes
436	Origin of Solar System	
425	Science of Orbiting	
2542	Flight of Apollo 7	
2340	Exploring the Edge of Space	18 minutes
2201	This Is Our Town: Transportation in Cincinnati	
124	Airport in the Jet Age	

Filmstrips

6512	Occupations in Aircraft Operation
6415	How Airplanes Fly

Information and Materials Lists

National Aeronautics and Space Administration
Langley Research Center
Langley Station
Hampton, Virginia 23365

Model Products Corporation
Mount Clemens, Michigan 48043

Estes Industries, Inc.
Penrose, Colorado 81240

CAREER ORIENTATION

Science

Appendix

Community Resources in the Science Area

The modern science teacher uses the resources of the community for purposes of enrichment and supplementation wherever practical. The extent to which community resources should be used will depend upon their potential usefulness in achieving the major goals of science instruction.

A careful survey of the opportunities offered by the Greater Cincinnati Community will reveal an extensive array of materials and phenomena which may be used by science teachers.

The following situations in cities, towns or rural areas are suggestive of the wide variety of community resources appropriate for teaching science:

1. Airports
2. Bird sanctuaries
3. Caves, gaps, and other interesting natural phenomena
4. Chemical and other industrial plants
5. Department of Health and Sanitation
6. Engineering project
7. Exhibits of garden clubs and flower shows
8. Field trips to observe agents of weathering and erosion at work
9. Greenhouses
10. Junk yards
11. Lakes, ponds, streams and bogs
12. Mines and quarries
13. Observatories and planetariums
14. Telephone building, radio stations and power plants
15. Stores and markets
16. Weather Bureau

Cincinnati resources are unlimited in the area of science. The city offers such places as the art museum, the zoo, city and county parks, universities, industrial laboratories and governmental research center.

The following is a suggestive list of community resources that may be correlated with some of the units in science:

Organizations	Resource Persons
1. Air Pollution Control League	Charles N. Howison, Director
2. American Chemical Society (Cincinnati Chapter)	Dr. Donald S. Hirtle
3. Chemical Industrial Council of Ohio	Carr Brownell, Davison Chemical, Division of W. R. Grace & Co.
4. Cincinnati Bell Inc.	Jerry Wright, School Relations Department
5. Cincinnati Dental Society	Dr. Ermal E. O'Brian Education Center - 621-7010
6. Cincinnati Gas & Electric Co.	Edward C. Pandorf
7. Cincinnati Milicron	Jack Cahall
8. Cincinnati Park Board	Dalton W. Battin, Superintendent of Parks, or Fred L. Payne, Assistant Superintendent of Parks
9. Engineering Society of Cincinnati	

A. Career Guidance Committee

Provide career guidance information to junior and senior high school pupils through field trips, speakers, symposiums and pamphlet materials, science, mathematics, and engineering.

B. Science Award Committee

Provides an opportunity for junior and senior high school pupils to participate in an award program in biology, botany, zoology, chemistry, physics, general science, and engineering.

Government bonds, cash awards are given to the winner - an equal amount is given to the schools of the winning pupils participating.

C. Speaker Bureau

An excellent list of speakers for resource persons to whom we may refer pupils.

Resource Person

Kenneth E. Vordenberg, Administrative Supervisor, Science - Secondary Education Center - 621-7010 - 282

11. Greater Cincinnati Tree Council

Field trips, lectures, demonstrations the "Save the Trees" posters contest, and the Arbor Day Civic Award luncheon make up the year's program.

Resource Person

Mrs. Arthur Faulwetter, President

12. Hamilton County Soil and Water Conservation District

The conservation district carries out a soil and water conservation educational program such as:

1. A conservation air tour
2. A tour of agronomy and conservation practices
3. Pond management clinics
4. A district newsletter published quarterly
5. Provides programs for school science departments
6. Serves as consultants for pupils and teachers

Resource Person

J. A. Odegard

13. Health Careers Association of Greater Cincinnati

The Health Careers Association of Greater Cincinnati operates a twelve month program devoted to education and information concerning opportunities for young people in the entire health field. For students it provides information on courses to take for all careers, opportunities to observe a chosen health career in a working situation, clubs in junior and senior high schools, and speakers and films for programs. For educators and counselors the Association provides literature to help answer questions from students and parents; opportunities to observe health careers first hand by visiting hospitals and health agencies; provides speakers and films for groups, classes and career events; and provides scholarship and loan fund information. In addition, it serves as a clearinghouse for the collection and distribution of information concerning accredited schools.

Resource Person

Edna Caywood, Executive Secretary — Community Chest Building 721-2915

14.	Heart Association of Southwestern Ohio	Michael J. Ryan, Jr. Executive Director Miss Mary Flugstad Program Director
15.	Hospitals	
	Bethesda Hospital	Harriet Janszen
	Christ Hospital	Mrs. Wood 421-9600
	General Hospital	
	Jewish Hospital	Mrs. Burns Nursing School 872-3545
		Mrs. Marilyn Blee Medical Technician
	Resource Person	Mrs. Edna Caywood Community Chest Building 721-2915
16.	Museum of Natural History	Mrs. Hoobler 621-3889
17.	Cincinnati Nature Center	John Oney, Director 831-1711
18.	Occupational Health Resource & Training Facility, U.S. Public Health	Dr. John M. Blankenhorn

Vocational Information

19. Encyclopedia of Associations
National Association of the U. S.
Gale Research Company
Detroit, Michigan

20. Vocational and Work Unit Files
Cincinnati Public Libraries

21. "Occupational Outlook Handbook"
Published by U. S. Department of Labor

Science Clubs

Science clubs may be divided into two groups; (1) the specialized interest club, such as the Radio Club, Nature Club, Health Careers Clubs, Amateur Scientists Club, Aviation Club, etc., (2) the general type club as the General Science Club, Biology Club, Chemistry Club and Physics Club.

The club offers the pupil an opportunity for specialization which he does not have in the classroom. In the classroom his work is more formal, in the club it is more informal; in the classroom he frequently is told what to do, in the club he chooses. In short, the club represents freedom and expression where the classroom represents conformity and regimentation.

The best results seem to be obtained in club work when the group is formally organized. This requires the adoption of a constitution. Meister, an authority on Science Club work, suggests the following questions to be answered during the framing of the constitution:

(1) What shall be the aim of and purpose of our science club?
(2) What shall be its name?
(3) Membership
    a. Who can become a member?
    b. What must a boy or girl do to become a member?
(4) Meetings
    a. When shall they be held?
    b. Where?
    c. How often?
    d. Who shall call for special meetings?
(5) Money
    a. Shall we pay dues?
    b. How much?
    c. Can we levy taxes?
    d. Now? How much?
    e. For what shall the money be used?
(6) Expelling members
    a. For what reasons?
(7) The Science Program
    a. How many different activities shall the club have?
    b. Who shall decide upon and arrange these programs?
(8) The Business Program
    a. How long shall be the procedure?
    b. Who shall decide upon and arrange these programs?

(9) Officers
   a. When shall election take place?
   b. How often?
   c. What officers shall we have?
   d. What shall be the duties of each officer?
   e. How can an officer be impeached?
   f. How can an officer resign?
   g. Shall officers filling positions left vacant be appointed or elected? And how?

(10) Any other regulations you think it important to put into the constitution.

Selected References

Forrester, Gertrude, Occupational Literature, an Annotated Bibliography, H. W. Wilson Company, New York, N. Y., 1953

Crosby, M. D., Edwin L. and Committee, Health Careers Guidebook, U. S. Government Printing Office, Washington, D.C.

Pamphlets

How to Organize a Science Club, The American Institute of the City of New York, 60 East 42nd St., New York City.

Students Handbook of Science, Frederick Ungar Publishing Co., New York City.

Sponsor's Handbook, Science Clubs of America, Science Service, Washington, D.C.

Health and Hygiene, Superintendent of Documents, Washington, D. C. 20402.

Also refer to Curriculum Bulletins #114, Science and Health, Grade 7, p. 189, Bulletin #115, Science and Health, Grade 8, p. 199.

CAREER ORIENTATION

Field Trips

The following technique is recommended for organizing and conducting a field trip:

A. Evaluate the advantages in order that as many as possible may be profitably utilized.

B. Determine the purpose for which the journey is to be conducted; or possible combination of purposes.

C. Examine survey data.

1. Materials that will develop correct concepts.

2. Situations around which activities may be organized that will assist pupils in developing desirable attitudes, skills, and habits.

D. Make necessary arrangements with

1. School authorities - including parental permission.

2. Owners or representatives of places to be visited.

E. Initiation of the Trip.

1. Develop the need - during class discussion, or group activity, etc.

2. Teacher preparation - familiarity with place, route, features, necessary reference materials.

3. Have pupils definitely fix the aims.

4. Pupils preparation.

(a) Equipment - notebook, field glasses, proper clothing, etc.

(b) Study of reference material.

(c) Spirit of alertness, determination to meet and solve situations.

F. Instruction enroute and the lesson.

1. On the way - pupil alert, at time noting and listing things seen; teacher a constant guide.

2. At the place - the definite lesson; pupil utilizing initiative, self-activity, observation, teacher guiding the organization of pupil observation.
3. The return --- pupil exchanging ideas, freely discussing experiences, asking questions, etc.
4. The follow-up.
   (a) Reports from pupils.
   (b) Discussion of reports; questions by pupils and teacher, evaluating.
   (c) Coordination of work.
   (d) Writing thank you letter to proper person at place visited.

G. Appraise the lesson.

1. Teaching values.
   (a) Enriching and vitalizing.
   (b) Motivating.
   (c) Socializing.
2. Constructive influence on pupils attitudes, habits, and skills.

Also refer to Curriculum Bulletin #114, Science and Health, Grade 7, p. 179, and Curriculum Bulletin #115, Science and Health, Grade 8, p. 189.

Table 16

CAREERS RELATED TO SCIENCE

Levels	Service	Business Clerical and Sales	Science and Technology	Outdoor	General Culture	Arts and Entertainment
I B. A. or above	Occupational Therapist Psychologist Psychiatrist Dietitian	Sales Engineer Mfg. Electronic Equipment	Anthropologist Chemist Medical Technologist Astronautic Engineer Physicist Engineer Mathematician Physician Biologist Botanist Veterinarian Pharmacist Nurse Dentist Chiropractor	Agronomist Wildlife Specialist Range Management Specialist Horticulturist County Agent Landscape Architect	Curator Science Teacher Physical Education Teacher	
II H.S. plus Technical	Mortician	Pharmaceutical Salesman Medical Secretary Chemical Secretary Salesman Scientific Supplies and Equipment	Biological Research Aide Dental Technician Dental Hygienist Optometrist Medical Technician	Floriculturist Nurseyman Tree Surgeon Fish Culturist Soil Conservation		Botanical Artist

			Weather Observer Practical Nurse Embalmer			
III High School Graduate	Masseur		Taxidermist Glassblower Dry Cleaner Textile Technician Laboratory Technician	Landscape Gardner Poultryman Truck Gardner Apiarist		
IV Less than High School Graduate			Veterinary Hospital Attendant Zoo Caretaker Nurse's Aide	Lumber Inspector Nursery Employees		Animal Trainer Photographic Technician

Chemistry. Field trips can show the diversity of the applied chemistry field and the relevance of chemistry to the jobs being observed. Worthwhile visits may be made to tile and ceramic plants, hospital laboratories, paper mills, dry cleaners, pharmaceutical supply houses, synthetic and plastic manufacturing firms, or other local industries. Scientists can be observed in food processing and preservation plants; e.g., bacteriologists, dietitians, chemists, and inspectors. Metallurgical principles are applied by welders, assayers, mining engineers, and metallurgists.